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THESIS

BIOLOGICAL WEAPONS ATTRIBUTION: A PRIMER

by

Elizabeth L. Stone Bahr

June 2007

Thesis Co-Advisors: Peter R. Lavoy
Anne Clunan

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The possibility of an enemy attack using biological weapons (BW) remains one of the biggest threats to U.S. and global security. U.S. defense and deterrence policies are based on the assumption that the perpetrator can be quickly and reliably identified. If perpetrators can conduct attacks without the fear of attribution or punishment, they can act with impunity. The ability to punish, therefore, rests on the ability to identify the perpetrator. Thus, the goal of attribution is at the root of all national security strategies. Unfortunately, there are three reasons why the attribution of BW attacks are very difficult: (1) the nature of biological weapons, (2) the unique restrictions the international environment places on BW attribution, and (3) the bureaucratic constraints and organizational overlap that domestic political environments can impose if a BW attack occurs. This thesis thus provides a basic epistemological framework for analysis for successful BW attribution, detailing the nature, methods, and limits of current BW attribution capabilities.

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BIOLOGICAL WEAPONS ATTRIBUTION:
A PRIMER

Elizabeth L. Stone Bahr
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Author: Elizabeth L. Stone Bahr

Approved by: Dr. Peter R. Lavoy
Thesis Co-Advisor

Dr. Anne Clunan
Thesis Co-Advisor

Dr. Douglas Porch
Chairman, Department of National Security Affairs

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ABSTRACT

The possibility of an enemy attack using biological weapons (BW) remains one of the biggest threats to U.S. and global security. U.S. defense and deterrence policies are based on the assumption that the perpetrator can be quickly and reliably identified. If perpetrators can conduct attacks without the fear of attribution or punishment, they can act with impunity. The ability to punish, therefore, rests on the ability to identify the perpetrator. Thus, the goal of attribution is at the root of all national security strategies. Unfortunately, there are three reasons why the attribution of BW attacks are very difficult: (1) the nature of biological weapons, (2) the unique restrictions the international environment places on BW attribution, and (3) the bureaucratic constraints and organizational overlap that domestic political environments can impose if a BW attack occurs. This thesis thus provides a basic epistemological framework for analysis for successful BW attribution, detailing the nature, methods, and limits of current BW attribution capabilities.

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LIST OF ACRONYMS AND ABBREVIATIONS

BTWC	Biological and Toxin Weapons Convention, full name is The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction
BW	Biological Weapons
CDC	Center for Disease Control
CIA	Central Intelligence Agency
DEFRA	Department for Environmental Food and Rural Affairs (UK)
DHHS	Department for Health and Human Services
DIA	Defense Intelligence Agency
DRC	Democratic Republic of the Congo
DRDC	Defense Research and Development Canada
FBI	Federal Bureau of Investigation
FMD	Foot and Mouth Disease
HAZMAT	Hazardous Materials
HMRU	Hazardous Materials Response Unit (FBI)
INTERPOL	International Criminal Police Ogranization
KGB	*Komitet Gosudarstvennoy Bezopasnosti;* Soviet State Security Committee.
LD50	Lethal Dose, 50; the amount of a dose of a pathogen that if, administered, would kill half the test population
LRN	Laboratory Response Network
NASD	National Agriculture Safety Database
NBFAC	National Bioforensics Analysis Center
NCEH	National Center for Environmental Health
SC	UN Security Council
SOPs	Standard Operating Procedures
UNDDA	United Nations Department of Disarmament Affairs
UNSC	United Nations Security Council
USAMRIID	United States Army Medical Research Institute for Infectious Diseases
USDA	United Sates Department of Agriculture

USPS	United States Postal Service
USSR	United Soviet Socialist Republic
WHO	World Health Organization
WMD	Weapons of Mass Destruction

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I. INTRODUCTION

A. DETERRENCE OF BIOLOGICAL WEAPONS IN A POST 9/11 THREAT ENVIRONMENT

> The gravest danger to freedom lies at the crossroads of radicalism and technology. When the spread of chemical and biological and nuclear weapons…occurs, even weak states and small groups could attain a catastrophic power to strike great nations…
>
> – President George W. Bush[1]

The possibility of an enemy attack using biological weapons (BW) on U.S. soil, U.S. allies, or troops abroad remains one of the biggest threats to U.S. and global security. The U.S. National Strategy to Combat Weapons of Mass Destruction emphasizes the diversity and unpredictability of such attacks and the need for new methods to deter the development and use of such weapons.[2] In today's threat environment, the United States has reserved the right to use all options—including the use of nuclear weapons—in response to a biological weapon attack by an enemy.[3]

Current and traditional approaches to U.S. defense and deterrence policies are based on one key assumption: that the perpetrator can be easily and reliably identified. Deterrence and national defense policies rest on the premise that those planning or responsible for attacks will be punished. If perpetrators can conduct attacks without the fear or possibility of punishment, they can act with impunity. The ability to punish, therefore, rests on the ability to identify the perpetrator. Thus, the goal that countries can successfully identify the perpetrator of an attack—the problem of attribution—is at the root of all national security strategies.

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[1] National Security Strategy of the United States of America (September 2002). Accessible at: http://www.whitehouse.gov/nsc/nss.pdf on January 15, 2005.

[2] National Strategy to Combat Weapons of Mass Destruction (December 2002). Accessible at: http://www.state.gov/documents/organization/16092.pdf on January 15, 2006.

[3] See Victor A. Utgoff, "Nuclear Weapons and the Deterrence of Biological and Chemical Weapons," *Henry L. Stimson Center Occasional Paper* no. 36 (October 1997). Accessed at: http://www.stimson.org/wmd/pdf/utgoff.pdf on March 11, 2007.

Despite this assumption, the correct and rapid attribution of biological weapons use remains very challenging. The ability to quickly and accurately link a biological outbreak to a particular biological agent and a specific perpetrator is essential if U.S. deterrence policies are to be effective.

Biological weapons attribution is an extremely complex problem. Biological agents are unique weapons, whose peculiarities make them significantly more difficult to attribute than any other WMD. Unless these challenges to the successful attribution of a BW attack are properly understood, U.S. defense policies will remain inadequate and ineffective—both at home and abroad. This thesis answers the question of why BW attribution is so difficult to achieve. Three reasons as to why BW attribution is so difficult are presented—the nature of biological weapons, the unique restrictions the international environment places on efforts of BW attribution, and the constraints domestic political environments can impose if a BW attack occurs. This thesis thus provides a basic epistemological framework for analysis on successful BW attribution, detailing the nature, methods, and limits of current BW attribution capabilities.

Despite increased awareness of the threat of biological weapons to U.S. national security and the problem they pose for identifying perpetrators[4]—the United States remains significantly under-prepared for truly defeating the biological weapons threat because it has not adequately addressed the problem of attribution. The United States may be making advances on identifying, responding to, and containing a BW outbreak, but it lacks the ability to identify and penalize the perpetrators of a BW attack. The unique nature of biological weapons makes the timely identification, characterization, and attribution of an attack critical, if policies of deterrence are ever to be effective both domestically and internationally. Without understanding the complexities of BW attribution, the perpetrator of any future BW attack will most likely remain unidentified—making stated U.S. and international bio-security policies ineffective and leaving future BW aggressors undeterred.

4 "Biodefense for the 21st Century," The White House, April 28, 2004. Accessed at: https://www.whitehouse.gov/homeland/20040430.html on January 15, 2006.

B. CHALLENGES OF BIOLOGICAL WEAPONS ATTRIBUTION

This chapter introduces the three major challenges of the successful attribution of a biological weapons attack: the nature of the weapons themselves, and the constraints created by domestic and international politics. This chapter first describes the challenges of biological weapons attribution, and why biological weapons—unlike nuclear and chemical weapons—are unique and much more difficult WMD to defeat and deter. Next it briefly details the specific deterrence conundrum of biological weapons—the problem of attribution—and how this conundrum affects U.S. biodefense policies. It then presents the controversy surrounding U.S. biodefense and how this controversy affects U.S. biodefense policies, including that of preemption.

1. The Unique Nature of Biological Weapons: Lack of Signatures

One of the biggest causes of concern regarding the deliberate use of biological weapons is the fact that the goals of biological warfare—to cause death and disease among enemy troops, civilians, plants, or animals—can also be symptomatic of a natural epidemic or disease outbreak. Because BW attacks consist of live organisms, toxins, viruses, and bacteria that are endemic and naturally occurring in some populations, there may be substantial potential for ambiguity about the origin—deliberate or natural—of any particular outbreak.[5] As stated in the White House's "Biodefense for the 21st Century,"

> Biological weapons attacks could cause catastrophic harm. They could inflict widespread injury and result in massive casualties and economic disruption. Bioterror attacks could mimic naturally occurring disease, potentially delaying recognition of an attack and creating uncertainty about whether one had even occurred. An attacker may thus believe that he could escape identification and capture or retaliation.[6]

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[5] Mark L Wheelis, "Investigation of Suspicious Outbreaks of Disease," in Raymond Zilinskas, *Biological Warfare: Modern Offense and Defense* (London: Lynne Rienner Publishers, 2000).

[6] "Biodefense for the 21st Century," The White House, April 28, 2004. Accessed at: https://www.whitehouse.gov/homeland/20040430.html on January 15, 2006.

Thus, unlike chemical and/or nuclear weapons, which have components not normally present in natural environments and that do possess identifiable signatures—alerting the world not only to their use, but also to the most likely perpetrator—biological weapons lack visibly identifiable signatures.[7] The agents often produce identifiable affects, but it is often unclear if the outbreak was caused by a deliberate of natural outbreak. Because BW weapons use live organisms that must incubate within a host before the effects can be seen or known, it is entirely plausible that a state or non-state actor could release a BW weapon and the world would not even know a WMD had been released for days or even weeks. For example, as will be discussed below, an anthrax outbreak can be both naturally occurring, as well as the result of a deliberate attack. However, because the anthrax organism takes a few days to incubate within a host and the onset of recognizable symptoms usually does not occur for two to three days after infection, a lot of valuable evidence of a deliberate attack can be lost simply because a person could have been exposed and infected with anthrax, but may not even know they were infected until after a week or two of the initial exposure.

2. The Problem of Biological Weapons Attribution: A Typology

Attribution can be defined as the ability to link an outbreak to a particular biological cause or source at a particular place and time, as well as linking the outbreak to the work of a specified human perpetrator. In short, the problem of attribution has three parts: identification of a biological outbreak, characterization of that outbreak as non-natural and deliberate, and identification of the perpetrator. In the case of biological weapons, before an attack can even be attributed, investigators first must examine a scene and identify and characterize an outbreak before a perpetrator can be identified.

a. Identify the Cause of a Biological Event

Different weapons often possess distinct, identifiable signatures that indicate their use. Nuclear weapons have the well-known signature of the mushroom cloud. Chemical weapons also sometimes characteristically display a signature cloud

[7] BW agents do lack visibly identifiable signature, but as will be discussed in Chapter II, BW agents can possess signatures at a molecular level.

when released, and potential victims can often see clouds of chemicals looming toward them before they are exposed to deadly gases. Biological weapons, however, almost entirely lack identifiable signatures. Crowds of people can be exposed to an onslaught of a weaponized biological agent, and not see, hear, taste, or smell any change in their environment.[8] Biological weapons truly are silent killers.

Because of the lack of signatures associated with a BW attack, investigators must first examine a particular disease outbreak and be able to identify whether the outbreak is a natural or unnatural epidemic. This first step sounds simple enough, but can be incredibly difficult to ascertain.

Biological weapons can be used in a myriad of ways, including the use of BW on crops, livestock, small groups of people, and even on targeted individuals as a form of assassination attempt. Perpetrators can be skilled enough to release just the right amount of disease agent in order to emulate a disease outbreak—so as to go unnoticed and unattributed—and have the disease outbreak be categorized as natural. Therefore, before the use of BW can be properly attributed, one must first be able to identity that a particular disease outbreak was, in fact, the result of a deliberate attack and not simply a natural outbreak of disease.

b. Characterize the Nature of the Biological Event: Deliberate or Not

After a particular disease outbreak is concretely labeled unnatural, and the result of biological weapons use, investigators must then be able to characterize the event as deliberate or not. Was it an accidental release of BW? There are many questions that need to be answered in order for a BW attack to be characterized, and large amounts of evidence are needed to concretely answer all of these characterization questions.

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[8] See Marilyn W. Thompson, *The Killer Strain* (New York: HarperCollins Publishers Inc., 2003), p. 44, for more information on the findings of Project White Coat, a series of tests between 1954 and 1973 by the U.S. military using human volunteers to analyze how bacteriological agents move through the human body. The volunteers were conscientious objectors who agreed to be infected with debilitating pathogens. In return, they were exempted from frontline warfare. Many of the volunteers in Project White Coat reported that they could not hear, taste, or smell any change in their environments while they were being exposed to various biological weapons agents. The White Coat volunteers were not infected with the most lethal microbes; their role was to test the effectiveness of new vaccines and antibiotics and as soon as they became ill, they were given medical treatment.

However, this step in the typology is critical—before the perpetrator of a BW attack can be identified, the attack must first be categorized as unnatural, and then the outbreak must be characterized as criminal and deliberate so concrete evidence can be collected.

c. Attribute the Outbreak to a Perpetrator

Lastly, there is the process of attribution. Once an outbreak has been identified as unnatural and characterization evidence has been collected and analyzed, the formal attribution of a BW attack can be advanced, and informal hypotheses about the perpetrators discarded. The attribution process, however, is not necessarily a linear progression—these sequences will most likely overlap in certain situations, and evidence and events may unfold more like a jigsaw puzzle before the overall picture is revealed. Even if one follows the attribution typology, however, it does not guarantee the successful attribution of a BW attack. Like in criminal homicide cases, sometimes—despite the evidence—the guilty party remains at large.

3. The Deterrence Conundrum

While the U.S. government has advanced new measures that assist in "confronting the biological weapons threat," including the establishment of BioWatch programs that detect biological weapons attacks, increasing the Strategic National Stockpile of medicines for treating victims of bioterror attacks, and increasing funding for bioterrorism research, the United States remains under-prepared in for BW attribution.[9] Even if new technology could alert the U.S. government within twenty-four hours that a BW agent has been released so that government officials may be able to control the spread of the disease and treat victims of the attack, the mechanisms and efforts to determine exactly *who* it was that launched the attack remain largely underdeveloped and ignored.[10]

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[9] Biodefense for the 21st Century," The White House, April 28, 2004. Accessed at: https://www.whitehouse.gov/homeland/20040430.html on January 15, 2006.

[10] See Margaret E. Kosal, "The Basics of Biological and Chemical Weapons Detectors," *Center for Nonproliferation Studies*, Research Story of the Week 23 November 2003, for further information on the limitations of biological agent detectors. Accessed at: http://cns.miis.edu/pubs/week/031124.htm on March 12, 2006.

If "deterrence is the historical cornerstone of U.S. defense,"[11] the current policies of U.S. biodefense measures must credibly convince potential criminals to not engage in criminal activities for fear that they will be apprehended and punished. In order for a BW user to fear punishment, norms, laws, and enforcement must be designed and implemented to enable governments to attribute attacks to perpetrators and to communicate that capacity to would-be attackers. The current norms, laws, and BW enforcement policies are significantly lacking in their ability to identify and attribute BW outbreaks and—to date—have failed to apprehend and punish BW violators. Thus, BW deterrence is falling short of its policy objectives.

Though the unique characteristics of biological weapons make attributing who used or released them extremely difficult to determine, attribution is possible. By understanding the unique epidemiology of biological weapons agents, coupled with the advancement of microbial forensics and more sound international and domestic policies that allow for more effective BW outbreak investigations, BW attribution—and not just detection—can be successful. With a firm understanding of the challenges of BW attribution, the United States will be in better position to reliably attribute the source of a BW attack, and respond as specified in its national security and defense strategies.

4. The Transnational Threat

If the focus of contemporary U.S. biodefense measures center around a mission of not only the overall security for the American people and U.S. allies, but also deterrence of the future use of BW, the United States government and its allies must recognize and address the perplexing problem of BW *attribution*—both at home and abroad.

In order for any U.S. biodefense measures to successfully deter any future BW user, both the U.S. government, as well as other national governments that are members of anti-BW proliferation regimes, must be able and willing to cooperate to determine and deter *who* it was that released a BW agent, not just *what* agent was released. BW Proliferation regimes like the BTWC and the Australia Group have long asserted that—due to the trans-boundary threat of biological diseases—the international community

11 "Biodefense for the 21st Century," The White House, April 28, 2004. Accessed at: https://www.whitehouse.gov/homeland/20040430.html on January 15, 2006.

must work together and cooperate with BW detection and investigation if attribution is ever to be achieved.[12] Biological weapons policy objectives must begin with detection and response, but have an end-game plan of apprehension, and—perhaps most importantly—prosecution, if laws prohibiting the use of BW are ever to be taken seriously and BW proliferation is ever hoped to be controlled or destroyed.

The BW threat is transnational. It is not just state actors that potentially could use BW on U.S. populations, troops, and allies; the threat also comes from non-state actors. The fear that Saddam Hussein or Kim Jung Il would ever obtain and use biological weapons on U.S. citizens and troops abroad has caused a lot of political and tactical consternation for defense planners. The threat of a non-state actor, like an Al Qaeda agent, obtaining and using BW on U.S. citizens within the United States causes an equal amount of consternation and fear for defense planners. Since the BW threat is transnational, the solution to countering the BW threat must also be transnational. As was outlined in the U.S. National Security Strategy,

> While our focus is protecting America, we know that to defeat terrorism in today's globalized world we need support from our allies and friends. Wherever possible, the United States will rely on regional organizations and state powers to meet their obligations to fight terrorism. Where governments find the fight against terrorism beyond their capacities, we will match their willpower and their resources with whatever help we and our allies can provide.[13]

In 1972, the international community joined together to create the Biological and Toxin Weapons Convention (BTWC), seeking the total disarmament and prohibition of biological weapons around the world.[14] The current members of the BTWC and other states and parties hoping to stop the proliferation and future use of BW must realize that the biological weapons threat, and subsequent deterrence policies, must be thought of cyclically. If state or non-state actors know that they can acquire and use BW without

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[12] See The Australia Group Objectives, at: http://www.australiagroup.net/en/agobj.htm.

[13] National Security Strategy of the United States of America (September 2002). Accessed at: http://www.whitehouse.gov/nsc/nss.pdf on January 12, 2005.

[14] For a list of current state parties to the BTWC, as well as those states who have yet to ratify the Convention, see: http://www.opbw.org/.

fear of identification or reprisal, they—and other—states will continue to proliferate, acquire, and use BW; no actor will be deterred from such behavior because there is no fear of reprisal

Alternatively, if expedient and accurate investigation and attribution of the release of a BW agent were possible, an actor would fear reprisal and prosecution for his actions—and would also fear proliferating, acquiring, or using BW in the future. Deterrence would be improved, and the BW threat cycle would be slowed, disrupted, or broken completely

Therefore, in order for the threat of BW use to be quelled and/or eventually defeated, the attribution problem is critical. Without the fear of punishment, made possible by attribution, future BW users will remain undeterred.

C. METHODOLOGY, ROADMAP, AND SOURCES

1. Methodology

This thesis analyzes a specific problem of arms control—the successful attribution of a suspected intentional disease outbreak, as well as a parallel examination of two cases: the 1979 Sverdlovsk anthrax outbreak, and the 2001 anthrax attacks in the United States (the Amerithrax case).These parallel examinations are designed to highlight the numerous technical, forensic, political, and psychological complexities of biological weapons attribution, and also focus attention on the potential areas for improving BW attribution.

In addition to analyzing, in detail, the three main impediments to successful BW attribution, this thesis explains how these impediments materialized in the 1979 Sverdlovsk anthrax outbreak and the 2001 Amerithrax anthrax outbreak.

2. Sources

In addition to reviewing primary and secondary literature as sources, this thesis incorporates data from current public health monitoring websites, congressional records, UN Security Council Resolutions, draft protocols, texts, government speeches, as well as declassified intelligence documents. Additionally, a major contribution to this thesis was person interviews scholars in the field, as well as with sources within the FBI that would

like to remain anonymous. And lastly, some of the information for this thesis came from discussions with scholars and government officials at an international conference entitled, "Identification, Characterization, and Attribution of Biological Weapons Use," organized by the Center for Contemporary Conflict, U.S. Naval Postgraduate School, in collaboration with King's College London Centre for Science and Security Studies and the Economic and Social Research Council (UK), and with support from the Advanced Systems and Concepts Office, U.S. Defense Threat Reduction Agency.[15]

3. Overall Thesis Roadmap

a. Chapter II

Following this introduction chapter, Chapter II describes the nature of biological weapons, the first of three major reasons why the attribution of a biological weapons attack is so difficult. Understanding the nature of BW agents is key to the first and second steps in the attribution typology—identification and characterization. Examining the complex nature of biological weapons agents, Chapter II delves deeply into the specifics of disease ecology and the importance of understanding the epidemiology of a suspected agent in order to successfully attribute a disease outbreak. Epidemiology is the branch of medicine and scientific research that deals with the detection of the source and cause of infectious disease outbreaks. The epidemiology of a biological warfare agent is extremely complex, and sets the stage for the entire subsequent investigation of the outbreak. It is often an agent's epidemiological factors that provide the first clues of criminal intent during a disease outbreak, and distinguish a BW attack from a natural disease outbreak.[16] Chapter II introduces four main categories of epidemiology that serve as identifying biological categories that are critical to any outbreak investigation—agent pathogenicity, infectivity, incubation period, and

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[15] See Dr. Anne Clunan, Dr. Peter R. Lavoy, and Ms. Elizabeth Stone Bahr, "Identification, Characterization, and Attribution of Biological Weapons Use," *Center for Contemporary Conflict Conference Report* (December 2006). Accessed at: http://www.ccc.nps.navy.mil/events/recent/bwconferenceDec06_rpt.asp on March 22, 2007.

[16] Jay C. Butler, Mitchell L. Cohen, Cindy R. Friedman, Robert M. Scripp, and Craig G. Watz, "Collaboration Between Public Health and Law Enforcement: New Paradigms and Partnerships for Bioterrorism Planning and Response," *Emerging Infectious Diseases* 8, no. 10 (October 2002). Found at: http://www.cdc.gov/ncidod/EID/vol8no10/02-0400.htm, accessed February 1, 2006.

virulence—and develop them with regard to *bacillus anthracis* or anthrax, the agent released in the USSR in 1979 and the United States in 2001.

b. Chapter III

The four epidemiology categories introduced in Chapter II must be thoroughly understood and analyzed during outbreak investigations so that all available clues as to what caused the disease outbreak can be successfully discerned, and the perpetrator of the attack can be properly attributed. Applying these to anthrax, Chapter III brings in examples from the cases of Sverdlovsk and Amerithrax to highlight how the nature of the biological weapons agent—anthrax—affects BW investigation and attribution.

c. Chapter IV

Chapter IV introduces another major hurdle to the successful attribution of a BW attack: the restrictions and complications international political environments place on the successful attribution of a BW attack. The actual location of a disease outbreak significantly influences the subsequent investigation of the epidemic. Contemporary international relations, norms, laws, and diplomacy all play a major part in either the successful attribution, or the complete sabotage of an investigation. However, knowledge of international laws and norms is not the same thing as compliance with international laws and norms. This chapter highlights the significance of international relations for attributing a BW disease outbreak, particularly in light of an ever-increasingly transnational BW threat. International cooperation is essential for compliance with BW outbreak detection, investigation, and attribution efforts.

d. Chapter V

Chapter V introduces another major challenge to the successful investigation and attribution of a BW attack by discussing the nature of the domestic political environment at the time of an alleged outbreak. A successful investigation of a disease outbreak is completely dependent on the cooperation of numerous national actors, including the victims of the epidemic, the public health officials in the locality of the

outbreak, the team doing the disease investigations, the government agencies initiating the investigation, and the local authorities where the disease outbreak took place. Chapter V highlights the complexities of domestic political environments on the successful attribution of BW use. Chapter V compares the general constraints imposed by domestic politics with the specific analysis of the domestic political environments during both the 1979 Sverdlovsk anthrax outbreak in the Soviet Union, as well as the hurdles of the strained, post-9/11 domestic political environment in the United States during the 2001 Amerithrax outbreak. This comparison furthers our understanding of how domestic environments where a government is the responsible "perpetrator" differ from those where the perpetrator was a non-state actor, and the difficulties of attribution under both sets of circumstances.

e. Chapter VI

Chapter VI, the conclusion, begins by reviewing the risks of failing to identify the source of an unnatural disease outbreak. It begins by briefly summarizing the three preceding chapters' conclusions on the problem of BW attribution, and will use this analysis to support the argument that successful BW deterrence is predicated on successful BW attribution. This analysis also supports the argument that the problem of attribution requires solutions to overcome the obstacles of the unique nature of biological weapons, as well as the complexities of the intra-governmental and international cooperation needed to coordinate attribution efforts.

The chapter concludes by showing how the combination of understanding both the integral steps of the attribution typology, as well as understanding a suspected agent's epidemiology and the nature of the domestic and international political environment at the scene of the outbreak, can ultimately lead to the success or the total failure of the ultimate attribution of the illegal use of biological weapons. The three main policy recommendations that can be taken away from this thesis are also presented: (1) BW attribution is not just a technical problem; policy-makers must continue to advance the capabilities of forensic epidemiology and microbiology. (2) The United States cannot solve the BW attribution problem if it acts in isolation. Disease—naturally occurring or

deliberately released—is a transnational problem. (3) Domestically, U.S. policy makers must push for new laws and standard operating procedures on BW investigation, evidence collection, and sample testing in the event of a domestic BW attack, and a ubiquitous, Congressionally-approved standard or proof for initiating a BW investigation must be established to ensure not only the attribution of a BW attack, but also the prosecution of those responsible for the attack, and the deterrence of any future attacks.

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II. UNDERSTANDING THE NATURE OF THE AGENT: THE IMPORTANCE OF EPIDEMIOLOGY FOR DISEASE INVESTIGATION AND ATTRIBUTION

A. INTRODUCTION

This chapter explains the vital importance of epidemiology—the branch of medicine that studies the causes, distribution, and control of disease in populations—on the investigation and attribution of an outbreak of disease caused by the release of a biological weapons agent. Infectious diseases can be classified according to their epidemiologic, clinical, and/or microbiologic features, and detailed knowledge of these characteristics are critical for the expeditious identification, investigation, and attribution of a BW agent. It is often an agent's microbiologic factors that provide the first clues of criminal intent during a disease outbreak.[17] Without an understanding of an agent's epidemiology, multiple lives and critical forensic evidence can be lost simply trying to identify a suspected infectious disease.

Chapter II is both technical and analytical. The chapter begins by describing the unique problem of biological weapons and the role infectious disease epidemiology plays in the attribution of the use of biological weapons. The chapter then identifies the characteristics of pathogenicity, infectivity, incubation period, and virulence to highlight the vital importance of understanding disease epidemiology. These three categories of indicators are unique to every organism, and each category should be rigorously assessed and analyzed if one is to, at any point, successfully attribute a biological weapons attack.

Next, Chapter II describes the pathogen *Bacillus anthracis*—commonly known as anthrax—as a case study agent to assess the unique characteristics of the pathogenicity, infectivity, incubation period, and virulence of a BW agent. Anthrax was chosen as a case study agent because fears of it being used as a biological weapon began more than eighty

[17] Jay C. Butler, et al. "Collaboration Between Public Health and Law Enforcement: New Paradigms and Partnerships for Bioterrorism Planning and Response." *Emerging Infectious Diseases* 8, no. 10 (October 2002). Accessed at: http://www.cdc.gov/ncidod/EID/vol8no10/02-0400.htm on December 18, 2005.

years ago.[18] Also, in 1999, the Centers for Disease Control and Prevention (CDC) created A, B, and C lists of biological agents that terrorists could use to harm civilians. An expert panel of doctors and scientists classified anthrax as a Category A bioterror agent. The CDC bioterror lists represent the biological agents that pose the greatest threats to national security due to their ease of transmission, high rate of death or serious illness, potential for causing public panic, and special public health measures an epidemic would require.[19] Thus, the threat of a biological weapons attack involving anthrax has been more studied and more feared than many other disease agents. Additionally, biologically engineered anthrax was the source of both the 1979 Sverdlovsk outbreak, as well as the anthrax outbreaks in the United States in the weeks after September 11th.

Chapter II then uses the findings of the biological agent evaluation—understanding the technical significance of agent pathogenicity, infectivity and incubation period, and virulence—and applies the same evaluation to analyze the specific epidemiological complications of the 1979 Sverdlovsk anthrax outbreak and the 2001 American anthrax outbreak. By juxtaposing generic, technical epidemiologic analysis with these two case studies, this chapter concludes by reaffirming that one of the biggest keys to the attribution of the use of biological weapons is simple infectious disease epidemiology; without a strong understanding of an organism's epidemiologic make-up, the successful attribution of the criminal use of a weaponized organism, as well as hopes of saving any victims of a BW attack, is incredibly jeopardized.

B. THE UNIQUE PROBLEMS OF BW ATTRIBUTION

Organisms and the diseases they are capable of unleashing are extremely complicated entities. The investigation and attribution of the suspected release of a weaponized disease-causing organism are equally as complicated. The use or alleged use of any WMD would immediately involve government officials, investigators, and forensic experts to attempt to identify the perpetrator of the attack. The unique thing

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[18] G.W. Christopher, "Biological Warfare: A Historical Perspective," *Journal of the American Medical Association* 278, no. 5 (August 6, 1997): 412-417.

[19] National Institute of Allergy and Infectious Disease, "Anthrax," National Institute of Health, U.S. Department of Health and Human Services, December 2005. Accessed at: http://www.niaid.nih.gov/factsheets/anthrax.htm on February 5, 2006.

about biological weapons, however—unlike nuclear or chemical weapons—is the fact that BW agents are *alive* and some can be found naturally around the world at any given moment. Because disease epidemics and pandemics occur naturally around the globe every day, the attribution of a biological weapons attack is first and foremost dependent on the successful identification of the organism that was used in the attack. As stated above, it is often an agent's microbiologic factors that provide the first clues of criminal intent during a disease outbreak.[20] Without a thorough understanding of how a particular organism acts naturally in its endemic environment, an actual biological weapons attack could occur, and public health officials could miss all the clues that would indicate the outbreak of disease was in fact *not* a natural epidemic, but instead the result of a biological weapons agent.

C. BIOLOGICAL THUMB PRINTS: FOUR KEY FACTORS IN AGENT EPIDEMIOLOGY

Every single organism possesses unique biological characteristics that can serve as an identifying thumb print. The four epidemiological categories of pathogenicity, infectivity, incubation period, and virulence always need to be assessed when investigating the suspected release of a BW agent in order to control the spread of the outbreak, properly diagnose and treat victims of the outbreak, and to investigate the agent thoroughly enough to collect evidence for the eventual attribution of the attack. (See Table 1).

[20] Butler, "Collaboration Between Public Health and Law Enforcement: New Paradigms and Partnerships for Bioterrorism Planning and Response."

Table 1. Epidemiological Categories Important to the Attribution of a BW attack.

Pathogenicity	Ability of a microbial agent to induce disease.
Infectivity	Minimum number of infectious particles required to establish an infection.
Incubation Period	Time between exposure to an infectious agent and the onset of symptoms or signs of infection.
Virulence	Measured by the case fatality rate or as the proportion of clinical cases that develop severe disease.

1. Pathogenicity

A pathogen is an organism capable of causing disease. Pathogens are infectious agents that cause disease and include viruses, bacteria, fungi, protozoa and higher parasites. Pathogenicity refers to the ability of a microbial agent to induce disease.[21] Understanding an agent's pathogenicity helps physicians and clinicians better understand how an agent makes a victim ill. Pathogenicity helps answer the question of exactly *how* an agent invades a host and takes over a victim's immune system.

When it comes to agents used as biological weapons, the pathogenicity of an agent becomes a critical piece of the ultimate attribution of the attack. For some agents—such as anthrax—a certain strain can invade a host in more than one way. Public health officials, emergency responders, and clinicians must have a thorough understanding of disease pathogenicity as an epidemiologic identifier, or the actual cause of disease can be misdiagnosed or missed altogether. The eventual attribution of the agent and source of a BW attack largely depends on properly identifying an agent's pathogenicity, for it is the pathogenicty of an agent that gives the biggest clues to the source of infection—whether the source of the infection was from something a person ingested or something a person breathed in from the air, etc. The pathogenecity gives investigators a better idea of the type of "crime scene" they should be focusing on for purposes of attribution.

[21] Kenrad E, Nelson, Carolyn Masters Williams, Neil MH Graham, *Infectious Disease Epidemiology: Theory and Practice* (Aspen Publishers, Inc., 2001), 27.

2. Infectivity

When faced with the daunting task of identifying a suspected agent in a disease outbreak or epidemic, another critical thing epidemiologists need to firmly identify is an agent's infectivity. Infectivity is the ability of an agent to cause infection in a susceptible host.[22] The basic measure of infectivity is the minimum number of infectious particles required to establish an infection.[23] In communicable diseases that spread from person to person—such as Ebola or Marburg—the proportion of susceptible individuals who develop infection after exposure (called the secondary attack rate) is a measure of the infectivity of an organism.

Infectivity is a good indicator that a particular outbreak is unnatural and the result of the use of BW weapon, versus a natural, endemic outbreak. If a particular agent outbreak usually causes ten to fifty people or animals to become sick, but a specific outbreak has infected 200 to 400 people, this level of infectivity is a red flag that the outbreak was not natural. By identifying the minimum infectivity of an agent, public health officials and government planners can gain a better grasp on precisely how many people are potentially infected, and ultimately how many victims the biological agent could claim. It is agent infectivity that makes biological weapons potentially more destructive than any other weapon of mass destruction.

3. Virulence

Virulence is defined as the severity of the disease after infection occurs.[24] Some fields use the terms virulence and pathogenicity interchangeably, but for purposes of understanding disease in the context of biological weapons, it is useful and important to consider these two terms to be separate properties of an infectious agent. Virulence is most often measured by the case fatality rate or as the proportion of clinical cases that develop severe disease.[25]

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[22] Kenrad E, Nelson, Carolyn Masters Williams, Neil MH Graham, *Infectious Disease Epidemiology: Theory and Practice* (Aspen Publishers, Inc., 2001), 27.

[23] Ibid.

[24] Ibid.

[25] Ibid.

Some diseases can be pathogenic and cause diseases which produce various symptoms, but other diseases are both pathogenic *and* virulent. An example would be smallpox and rhinoviruses[26]—both are pathogenic, but smallpox infections are much more virulent.[27] This distinction is important for purposes of studying biological weapons agents because both a weaponized and a naturally occurring agent can have the same pathogencity, but the agent can have an extremely more lethal virulence in its weaponized form. Anthrax, for example, can infect its host in the same manners in both its natural and weaponized form—either cutaneously through the skin, gastrointestinally through the stomach by being eaten with rotten food, or pulmonarily when breathed in through the lungs. However, the virulence of weaponized versus naturally occurring anthrax once it has achieved its pathogenesis can have dramatically different results; weaponized anthrax is much more virulent. The virulence of a disease is some times dependent on the pathogenicity of the disease; how a particular agent invades a host can determine the relative virulence of the particular agent in that specific circumstance—this will be further elucidated in the example of anthrax's virulence levels, discussed below. In fact, it is often a disease outbreaks heightened level of virulence that provides investigators with the first clue that an un-natural, potential BW outbreak of disease has occurred. This is why it is important that pathogenecity and virulence be examined as separate epidemiological thumb prints needed for successful BW attribution.

4. Incubation Period

The incubation period of an infectious disease is the time between exposure to an infectious agent and the onset of symptoms or signs of infection.[28] Once a suspected BW agent and its pathogenesis (how it has infected its host) is identified, it is often the incubation period that provides the most solid forensic evidence that ultimately leads to a successful attribution of an outbreak or potential attack. The incubation period for

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[26] Rhinoviruses are the most common viral infective agents in humans. The most well-known disease caused by rhinoviruses is the common cold. There are over 100 virus types that cause cold symptoms, and rhinoviruses are responsible for approximately 50 percent of all cases.

[27] Nelson, *Infectious Disease Epidemiology: Theory and Practice*, 27.

[28] Nelson, *Infectious Disease Epidemiology: Theory and Practice*, 26.

infectious diseases always show some variation, which occurs for a variety of reasons, including: the dose or inoculum of the infectious agent, the route of inoculation, and the rate of replication of the organism.[29] However, despite this variance, if one can successfully track the emergence of a disease based on its suspected incubation period, one can usually find that a plot of the incubation period for persons exposed at the same time follows a normal log distribution, and times and places of infection for each casualty can usually be reliably deduced. This information can sometimes provide solid evidence to an exact location and time—the when and where—of the release of a biological weapon agent, and potentially bring an investigation one giant step closer to the successful attribution, and understanding of who was responsible.

D. TECHNICAL BIOLOGICAL THUMB PRINTS AND BACILLUS ANTHRACIS

Bacillus Anthracis derives from the Greek word for coal, *anthrakis*, because the disease causes black, coal-like skin lesions (See Image 1).[30]

Image 1. Two examples of necrotic skin lesions caused by a cutaneous anthrax infection.[31]

29 Nelson, *Infectious Disease Epidemiology: Theory and Practice*, 27.

30 Thomas V. Inglesby, "Anthrax as a Biological Weapons: Medical and Public Health Management," *Journal of the American Medical Association* (JAMA) 281, no. 18 (May 12, 1999), 1737.

31 Pictures from American College of Physicians: Internal Medicine, Bioterrorism. Accessed at www.acponline.org/bioterro/anthrax/cut_anth.htm, on March 10, 2007.

The major sources of natural human anthrax infections are through direct or indirect contact with infected animals, or occupational exposure to infected contaminated animal products.[32]Anthrax spores, which are aerobic and gram-positive, germinate when they enter an environment rich in amino acids, nucleosides, and glucose—such as that found in the blood or tissue of an animal or human host. [33] Anthrax can be found globally, and is endemic and more common in developing countries or countries without veterinary public health programs. Certain regions of the world (South and Central America, Southern and Eastern Europe, Asia, Africa, the Caribbean, and the Middle East) report more anthrax in animals than others.[34] Also, anthrax is not a communicable disease, meaning that it cannot be spread from person to person.

Before delving into the identifying signatures of anthrax, it is worthy to note that it is possible to classify organisms based on the three identifying characteristics of infectivity, pathogenicity, and virulence, and very few diseases in the world can be classified as ranking high in any single category; anthrax is one of the diseases that ranks high in all three categories. This fact makes anthrax a very attractive biological weapon. (See Table 2).

Table 2. Classification of Disease Rankings.[35]

SEVERITY	INFECTIVITY	PATHOGENICITY	VIRULENCE
HIGH	Smallpox, measles, chicken pox, anthrax	Smallpox, rabies, measles, anthrax, chicken pox, common cold	Rabies, smallpox, tuberculosis, leprosy, anthrax
INTERMEDIATE	Rubella, mumps, common cold	Rubella, mumps	Poliomyelitis, measles
LOW	Tuberculosis	Tuberculosis, Poliomyelitis	Measles, chicken pox
VERY LOW	Leprosy	Leprosy	Rubella, common cold

[32] PCB Turnbull, *Guidelines for the Surveillance and Control of Anthrax in Humans and Animals, 3rd Edition* (World Health Organization: Emerging and Other Communicable Diseases, Surveillance and Control), 10.

[33] Inglesby, "Anthrax as a Biological Weapons: Medical and Public Health Management," 1737.

[34] Center for Disease Control and Prevention, "Anthrax," *Division of Bacterial and Mycotic Diseases*. Found at: http://www.cdc.gov/ncidod/dbmd/diseaseinfo/anthrax_g.htm#What%20is%20anthrax. Accessed on February 5, 2006.

[35] Nelson, *Infectious Disease Epidemiology: Theory and Practice*, 27.

1. Anthrax Pathogenicity

The pathogenicity of anthrax helps explain why this particular bacterium, as a biological weapon, is potentially so disastrous, whereas naturally occurring anthrax is now easily preventable and controllable.

Remembering that pathogenicity helps explain *how* an organism causes disease—or literally how the bacteria enters the body of the host—it is extremely important to realize that there are three different ways in which the anthrax bacteria can invade a host. A person or animal[36] can develop gastrointestinal anthrax, cutaneous anthrax, or pulmonaryal anthrax.

a. Gastrointestinal Anthrax Pathogenicity

A case of gastrointestinal anthrax occurs when a person consumes meat or an animal consumes feed meal that is infected with the bacteria. This form of anthrax is most commonly found in poorer locations around the world that have inadequate cattle breeding practices and lack of resources, where farmers do not vaccinate their animals to avoid extra costs, and where unregulated black market meat sales are common.

A recent outbreak of anthrax in southern Kyrgyzstan highlights the risks and distinct pathogenicity of gastrointestinal anthrax. In October 2005, the former Soviet Republic in Central Asia reported over two dozen cases of gastrointestinal anthrax, forcing doctors to implement a strict quarantine and public officials to close down cattle markets to prevent the spread of the disease.[37] In Kyrgyzstan, poor farmers and butchers commonly graze and slaughter hundreds of animals, year after year, in the same fields and slaughter houses. Experts cite places where anthrax infected animals were slaughtered and/or buried in the past as the major cause of recent, natural anthrax outbreaks. The danger lies in the blood that spills from the animal and drains into the soil,

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[36] Anthrax is usually an endemic epizootic disease, meaning it can affect a large number of animals at the same time within a particular region or geographic area.

[37] Central Asia, "KYRGYZSTAN: Anthrax on the rise in south," United Nations Integrated Regional Information Network (IRIN), October 26, 2005. Accessed at http://www.irinnews.org/report.asp?ReportID=49765&SelectRegion=Asia&SelectCountry=KYRGYZSTAN on January 15, 2006.

where the anthrax can then assume a protective spore form.[38] If an animal is infected with anthrax and buried in the ground, other animals grazing upon those grounds can be infected with the bacteria emanating from the bodies of the buried animals; the bacteria thrives in the soil and grass of the animal burial grounds, and can reinfect other animals grazing in those areas.[39]

There are more than 550 such anthrax hot spots in southern Kyrgyzstan, while only 350 of them have been detected, registered, fenced, and covered with concrete to prevent infection in other cattle.[40] The majority of these spots remain unattended, and there are no warning signs for local people to know not to graze their cattle there. Therefore, new animals graze where infected animals are buried, causing new anthrax outbreaks in the animal. Once those animals are slaughtered, people consume the infected meat of the animals, and—in turn—are overcome by the pathogenesis of gastrointestinal anthrax. This vicious circle in Kyrgyzstan is common throughout the undeveloped world, and accounts for a large percentage of annual gastrointestinal anthrax cases in humans.

b. Cutaneous Anthrax Pathogenicity

Cutaneous anthrax is said to account for 95 percent or more of human cases globally.[41] Most endemic, naturally occurring cases of anthrax are cutaneous, and are contracted by close contact of abraded skin with products derived from infected herbivores, principally cattle, sheep, and goats.[42] Such products might include hides, hair, wool, bone, and meal. A human or animal must have an open cut come in contact with the bacteria in order to develop a cutaneous anthrax infection.

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[38] Jeanne Guillemin, *Anthrax: The Investigation of a Deadly Outbreak* (Berkeley, CA: University of California Press), 3.

[39] Anthrax's survival in soil depends largely on temperature. If possible, soil at the site of an anthrax carcass should be removed up to a depth of 20 cm and incinerated or heat treated. Where it is not feasible to incinerate or chemically decontaminate the soil or to remove it to an incinerator, the alternative is to close off or seal the site with concrete or tarmac. This scenario becomes heavily relevant later in this Chapter, when the Sverdlovsk anthrax outbreak is discussed.

[40] Central Asia, "KYRGYZSTAN," Ibid.

[41] Turnbull, *Guidelines for the Surveillance and Control of Anthrax in Humans and Animals*, 14.

[42] Theodore J. Cieslak and Edward M. Eitzen, Jr., "Clinical and Epidemiologic Principles of Anthrax," *Emerging Infectious Diseases* 5, no. 4 (July-August, 1999). Accessed at: http://www.cdc.gov/ncidod/EID/vol5no4/cieslak.htm on January 15, 2006.

c. Pulmonary Anthrax Pathogenicity

Many experts agree that one of the biggest things preventing terrorists from dispensing weaponized, aerosolized anthrax onto a population—causing widespread cases of pulmonary anthrax infections—is the challenge of the delivery mechanism. A person cannot develop pulmonary anthrax unless the released spore size is delivered in precisely the right measurement so as to maximize infectivity and virulence, as discussed below. It is now known that in June 1993, the Aum Shinrikyo cult sprayed a liquid suspension of *B. anthracis* from its headquarters in Kameido, near Tokyo, Japan.[43] This release of anthrax went unnoticed, and thankfully resulted in no deaths largely because Aum Shinrikyo's delivery mechanism was unsuccessful.

Whereas cutaneous and gastrointestinal anthrax are characterized by very visible and recognizable symptoms, pulmonary anthrax is much more difficult to diagnose—not only because of its complications, but because so few cases have ever been reported and documented. Before the 1979 anthrax outbreak in Sverdlovsk, very few doctors had the training or ability to diagnose a case of pulmonary anthrax. And even during the 2001 Amerithrax outbreak in the United States, with a sophisticated medical community and well-trained physicians, many of the doctors who first had contact with the outbreak's first victims believed their patients were merely suffering from flu or fatigue. The doctors had little experience and training in recognizing the symptoms of pulmonary anthrax, and some of their patients rapidly died as a result.[44]

The unique pathogenesis and subsequent symptoms of the various forms of anthrax is extremely important to understand in the event of a BW outbreak.

2. Anthrax Infectivity

A 1993 report by the U.S. Congressional Office of Technology Assessment estimated that between 130,000 and three million deaths could follow the aerosolized

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[43] Paul Keim, "Molecular Investigation of the Aum Shinrikyo Anthrax Release in Kameido, Japan," *Journal of Clinical Microbiology* 39, no. 12 (December 2001), 4566.

[44] See "Anthrax in America: Chronology and Analysis of the Fall 2001 Attacks," *Center for Counterproliferation Research* (November 2002).

release of 100 kilograms of anthrax spores upwind of the Washington, D.C. area—lethality matching or exceeding that of a hydrogen bomb.[45] Additionally, of the many biological weapons that may be used as weapons, the Working Group on Civilian Biodefense has identified anthrax as one of the most serious organisms that could cause disease and death in sufficient numbers to cripple a city or region.[46] Anthrax has a very high level of infectivity, in multiple forms, thus making it a very attractive organism for use as a biological weapon.

Remembering that infectivity is the minimum number of infectious particles required to establish an infection, it is critical to note that the infectivity of anthrax depends heavily on its pathogenicity in each circumstance. The level of infectivity is a factor that terrorists or states intending to weaponize and disseminate anthrax spores would have to pay particular attention in order to maximize resulting infections. One must understand an agent's infectivity in order to properly equip a dissemination device with the precise amount of spores needed to cause widespread death and destruction.

a. Cutaneous Anthrax Infectivity

It does not take many spores to initiate a cutaneous anthrax infection, but an open cut or abrasion must be present that anthrax spores can gain access to before anthrax can cause infection in a host.[47] Although few spores need to be present before a cutaneous anthrax infection takes root, this version of the disease is readily recognizable, presents limited diagnosis, is amenable to therapy with any number of antibiotics, and is rarely fatal.[48]

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[45] Office of Technology Assessment, U.S. Congress, *Proliferation of Weapons of Mass Destruction* (Washington D.C.: U.S. Government Printing Office, 1993), 53-55. Publication OTA-ISC-559.

[46] Inglesby, "Anthrax as a Biological Weapons: Medical and Public Health Management," 1735.

[47] Turnbull, *Guidelines for the Surveillance and Control of Anthrax in Humans and Animals*, 12. The exact amount of spores that represents a cutaneous or gastrointestinal risk remains unknown.

[48] Cieslak, "Clinical and Epidemiologic Principles of Anthrax."

b. Gastrointestinal Anthrax Infectivity

There is very little information on infectious doses of anthrax by the oral, gastrointestinal route, but what is true for the skin is probably largely true for the oropharyngeal and gastrointestinal epithelium (see above).[49]

c. Pulmonary anthrax Infectivity

Pulmonary anthrax has tremendously more ability to kill victims than cutaneous or gastrointestinal anthrax. Although aerosolized anthrax spores are the rarest form of anthrax, they are the deadliest form of anthrax, and thus the most likely form that weaponized anthrax would be in. A World Health Organization report estimated that in the three days after the release of just fifty kilograms of anthrax spores along a two kilometer line upwind of a city with a population of 500,000, up to 125,000 infections would occur, eventually producing 95,000 deaths after the disease incubates and takes hold of its victims.[50]

Current biological terrorism models that estimate casualties from the release of aerosolized anthrax spores assume a point-release of one kilogram of spores, concentrated at a trillion spores per gram.[51] This figure gives an approximation as to the precise level of infectivity of aerosolized anthrax spores to cause maximum death and destruction. Also, anthrax spores lend themselves well to aerosolization and resist environmental degradation.[52] This fact, coupled with the scenario that it would take just fifty kilograms of properly disseminated and aerosolized anthrax to maximize the agent's infectivity levels makes pulmonary anthrax an extremely attractive biological weapons option.

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[49] Turnbull, *Guidelines for the Surveillance and Control of Anthrax in Humans and Animals*,12.

[50] Julie Pavlin, "Epidemiology of Bioterrorism," *Emerging Infectious Diseases* 5, no. 4 (July-August 1999). Accessible at: http://www.cdc.gov/ncidod/eid/vol5no4/pdf/pavlin.pdf on March 10, 2006.

[51] G.F. Webb, "A Silent Bomb: The Risk of Anthrax as a Weapon of Mass Destruction," *Proceedings of the National Academy of Sciences of the United States of America* 100, no. 8 (15 April 2003), 4355.

[52] Cieslak, "Clinical and Epidemiologic Principles of Anthrax."

3. Anthrax Virulence

The U.S. Department of Defense bases its biological weapons defense strategies on the scientific data estimating that the Lethal Dose, 50 Percent (LD50)—the amount of a dose administered that would kill half the test population—for humans with pulmonary anthrax is 8,000 to 10,000 spores.[53] To get a better sense of anthrax's virulence, it is important to note that it takes roughly 2,500 spores to become infected with pulmonary anthrax, and a lethal dose of 10,000 spores can be inhaled in *one breath*.[54] For some people, such as elderly people or those whose immune systems are already weakened by pre-existing infections, the number of spores required for infection can be much lower.[55] With pulmonary anthrax, death is universal in untreated cases and may occur in as many as 95 percent of treated cases if therapy is begun more than forty-eight hours after the onset of symptoms.[56]

Anthrax was a major component of many states' past offensive biological warfare programs.[57] Many of these programs concentrated on developing extremely virulent strains of treatment-resistant anthrax in order to maximize its effects.[58] Combining the data of anthrax virulence with the estimated infectivity levels that a terrorist could use to maximize the number of deaths in a given population, one can see that if one kilogram of weaponized aerosolized anthrax contains approximately one *trillion* spores, and only

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[53] Turnbull, *Guidelines for the Surveillance and Control of Anthrax in Humans and Animals*, 12.

[54] Marilyn W. Thompson, *The Killer Strain: Anthrax and a Government Exposed* (New York: HarperColins, Inc., 2003), 29.

[55] See discussion of victim Kathy Nguyen and the Amerithrax attacks, below, beginning on page 43.

[56] Cieslak, "Clinical and Epidemiologic Principles of Anthrax." However, it should be noted that the Amerithrax case showed the administration of the proper antiobiotics after exposure to anthrax did prove to be effective, even after 48 hours passed between exposure and treatment.

[57] The United States, the United Kingdom, the former USSR, South Africa, Iraq, and Japan are among some states that were known to have developed weaponized anthrax in past state-led offensive biological warfare programs.

[58] See Ken Alibek, *Biohazard* (New York: Dell Publishing, 1999), 259, where Alibek describes Biopreparat's successful creation of "chimera viruses;" virus combinations—like the mentioned Ebola-smallpox combo—that resist common vaccines and are much more virulent than the lone BW agent. The Soviet Union also developed a BW strategy for hiding deadly viral genes inside some milder bacterium's genome, so that medical treatment of a victim's initial symptoms from one microbe would trigger a second microbe's growth. See Mark Williams, "The Knowledge," *Technology Review* (March/April 2006), 4. Accessed at: http://www.technologyreview.com/read_article.aspx?ch=biotech&sc=&id=16485&pg=1 on July 17, 2006.

8,000 to 10,000 spores per person are required to kill half the population in a given area (LD50), the scenarios involving terrorists releasing upward of fifty kilograms of aerosolized anthrax present mind-numbing scenarios of death and destruction.

4. Anthrax Incubation Period

Anthrax spores have an amazing survival capacity, and are markedly resistant to biological extremes like heat, cold, pH, desiccation, chemicals (and thus to disinfection), irradiation, and other adverse conditions.[59] Anthrax has been known to survive, deep in frozen bits of earth, for as long as seventy years.[60]

The incubation period of anthrax in a susceptible host ranges from thirty-six to seventy-two hours, and usually progresses into its debilitating phases without any prior discernable symptoms.[61] With pulmonary anthrax, the incubation period occurs after a period of one to six days.[62] The incubation period as an indicator is one of the major epidemiologic factors that can lead to the successful attribution of a BW attack because, if extrapolated, an epidemic curve can be created. The disease pattern is an important factor in differentiating between a natural outbreak and an intentional attack, and can usually discern when and where each victim first became ill.[63] However, in some cases, simply identifying *where* a victim contracted a disease does not present enough evidence to determine *who* it was that released the disease.

E. CONCLUSION

This chapter assesses the vital importance of disease epidemiology on the successful attribution of a biological weapons attack. The five vital epidemiological characteristics that are necessary to study for any agent suspected in a BW attack are: pathogenicity, infectivity, virulence, and incubation period. If any investigation of the

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[59] Turnbull, *Guidelines for the Surveillance and Control of Anthrax in Humans and Animals,* 7.

[60] Guillemin, *Anthrax: The Investigation of a Deadly Outbreak*, 233-234.

[61] Turnbull, *Guidelines for the Surveillance and Control of Anthrax in Humans and Animals*, 7.

[62] Cieslak, "Clinical and Epidemiologic Principles of Anthrax."

[63] Pavlin, "Epidemiology of Bioterrorism," Ibid.

suspected use of BW is undertaken and any one of these biological thumb prints is overlooked or miscalculated, the source of the attack could quite possibly never be attributed.

By analyzing one agent—anthrax—in detail, this chapter shows how complicated each epidemiological characteristic can be, and how important each characteristic is both independently and when examined as details of an agent's cohesive whole.

III. SVERDLOVSK AND AMERITHRAX: EPIDEMIOLOGY OF TWO ANTHRAX OUTBREAKS

A. INTRODUCTION

This thesis uses the 1979 Sverdlovsk anthrax outbreak in the former Soviet Union, as well as the deliberate use of anthrax as a biological weapon in the 2001 "Amerithrax" outbreak in the United States as two juxtaposed case studies to analyze the actual complications of the attribution of a biological weapons agent. Chapter III analyzes the complications of the particular epidemiology of the Sverdlovsk and Amerithrax anthrax outbreaks, using the chapter's previously presented and analyzed epidemiologic facts and details about anthrax to discern how and why it took over twelve years to concretely attribute the actual source of the anthrax outbreak in Sverdlovsk, USSR, and why the use of anthrax as a biological weapon in the 2001 Amerithrax crimes remains unsolved.

B. SVERDLOVSK

The Sverdlovsk case study shows, it was, effectively, the fabrication of anthrax's epidemiological characteristics that prevented the proper attribution of the Sverdlovsk outbreak. Because the Sverdlovsk anthrax outbreak occurred in 1979, when the USSR was a closed, hostile society, making an international investigation of the incident impossible, epidemiology was the only tool Western scientists had to determine the source of the Sverdlovsk anthrax outbreak.

Anthrax is endemic to all regions of Russia, and natural outbreaks of the disease remain common today. In the past, czarist Russia and the former Soviet Union had among the world's highest levels of recorded anthrax outbreaks.[64] However, in April of 1979, an anthrax outbreak occurred in what was then Sverdlovsk, USSR (now Yekaterinberg)[65], that was so sudden and virulent, many people suspected that the outbreak was not natural in any way.

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64 Guillemin, *Anthrax: The Investigation of a Deadly Outbreak*, 4.

65 There are two possible English spellings for the name of the city. Ekaterinburg represents direct transliteration from Russian, while Yekaterinburg tries to show the correct pronunciation. Both spellings are used equally often.

Toward the end of the 1970s, despite the Soviets Union's public support and ratification of the Biological and Toxin Weapons Convention (BTWC), the West had long doubted the sincerity of the Soviets declaration to end its offensive biological weapons program. In fact, by 1980, Western intelligence circles had begun to hear rumors of an outbreak of disease that had claimed hundreds, possibly thousands of victims. According to declassified, U.S. intelligence reports,

> A source reported that in late May 1979, a persistent rumor heard on the streets of Moscow was that some sort of disaster had occurred in Sverdlovsk earlier in the month. Several hundred people had died from an unknown cause. Authorities in Sverdlovsk first thought diseased cattle in the area… had caused the deaths. Later investigations… indicated that… an airborne disease may have been the true culprit.[66]

At first, not only were Western governments unsure of what disease caused the outbreak in Sverdlovsk, but medical personnel on the ground in the area accompanying the emergency transport vehicles were incorrectly and prematurely making an initial diagnosis of pneumonia.[67] Soon after the outbreak, however, the hospitals treating the outbreak patients were taken over by the military and completely sealed off from the public, and Soviet health officials descended on Sverdlovsk to control not only the outbreak, but rumors as to its origins.[68] As more people fell ill, and as the victims' symptoms began to look less like pneumonia, many doctors and common citizens alike began to suspect that a virulent anthrax epidemic had overtaken Sverdlovsk. But where had the victims of this deadly disease come into contact with the bacteria? The public officials and the Soviet government had one explanation, while the doctors treating the patients, common citizens of Sverdlovsk, and Western intelligence circles had another explanation.

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[66] Declassified Intelligence Report, "Trends and Developments: Foreign Technology and Weapons Systems," *Defense Intelligence Agency* (3 March 1980), 11.

[67] Faina A. Abramova, Lev M. Grinberg, Olga V. Yampolskaya, David H. Walker, "Pathology of Inhalation Anthrax in 42 Cases from the Sverdlovsk Outbreak of 1979," *Proceedings from the National Academy of Sciences of the United States of America* 90, no. 6 (March 15, 1993), 2291. Accessed at: http://www.pnas.org/cgi/reprint/90/6/2291 on January 10, 2006.

[68] Declassified Intelligence Report, "Trends and Developments: Foreign Technology and Weapons Systems," *Defense Intelligence Agency* (3 March 1980), 11.

1. Sverdlovsk Pathogenicity

a. Governments Report: The Bad Meat Theory—An Outbreak of Gastrointestinal Anthrax

After the outbreak, the Soviet government released official reports stating that the anthrax outbreak in Sverdlovsk had been the result of tainted meat being sold in the regions surrounding the city. Dr. Pyotr Burgasov, the Soviet Deputy Minister of Health and the official in charge of the public health response to the epidemic offered two pieces of evidence to support this theory: veterinary and pathological evidence.[69] Burgasov insisted that, supporting the veterinary evidence, an epizootic, natural outbreak of anthrax had occurred in sheep and cattle in April of 1979, and this tainted meat was the source of human illness. Additionally, Burgasov cited that autopsies performed on victims of the outbreak demonstrated disease in the gastrointestinal tract, particularly in the small intestine.[70] Burgasov insisted this pathological and epidemiological evidence was indicative of a food-borne epidemic from tainted meat which had been improperly processed, handled, cooked, and illegally sold.[71]

The Soviet government's tainted meat theory as the pathogenesis of the anthrax epidemic was not too far fetched; since the 1970s, the black market economy in Russia accounted for as much as 20 percent of national output, and many Russian people acquired food, especially farm products, from nonofficial sources.[72] These undocumented, unregulated food distribution channels were often found to be the source of many food-borne illnesses, and had—in the past—been identified as the source of anthrax infected meat that subsequently infected local populations. Many Soviet government officials insisted that anyone suggesting that the anthrax outbreak was anything other gastrointestinal was, in fact, just spreading malicious propaganda.

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69 Chris Holmes, M.D., *Spores, Plagues, and History: The Story of Anthrax* (Dallas, TX: Durban House, 2003), 183.

70 Holmes, *Spores, Plagues, and History*, 184.

71 Ibid.

72 Guillemin, *Anthrax: The Investigation of a Deadly Outbreak*, 24.

A March 1980 *Tass* article entitled, "A Germ of Lying," advanced the Soviet argument that a natural outbreak of anthrax had occurred among some of the livestock in the Sverdlovsk area, and condemned the U.S. accusations of the release of a BW agent as part of a plan for spurring the arms race, intensifying tensions, and waging psychological warfare against the USSR.[73] Despite these official publications and statements, however, many people—in the political and medical communities inside and outside the USSR—were skeptical that the official pathogenesis of the anthrax outbreak was, in fact, gastrointestinal.

b. Real Report: Biological Weapons Incident—An Outbreak of Pulmonary Anthrax

As the full scope of the outbreak began to emerge, a gastrointestinal outbreak of anthrax from infected meat seemed to be less probable. Many people began to suspect that the epidemic, in fact, possessed an entirely different pathogenicity than what was being claimed: a pathogenicity that was much more virulent and deadly than gastrointestinal anthrax. Most people agreed the disease in question was, in fact, anthrax. The controversy, however, was over the actual pathogenesis of the outbreak.

The initial evidence of a *pulmonary* anthrax outbreak was discovered by the same pathologists whose work Burgasov cited as evidence of a gastrointestinal outbreak. Faina A. Abramova, a pathologist working in one of the Sverdlovsk hospitals where victims of the epidemic were being treated, managed to hide her notes, microscopic slides, and tissue samples from the KGB, who removed and destroyed the hospital records of the patients affected by the anthrax outbreak; the Soviet government refused to support, and attempted to destroy all epidemiological evidence, that would implicate an aerosolized release of anthrax. Abramova's medical notes remain some of the only remaining original copies of medical observations of the outbreak patients that

[73] Leonid Kraskov "Anthrax Propaganda Used to Poison World Situation," translation of "A Germ of Lying," *Tass* in FBIS, USSR International Affairs—Disarmament/SALT/MBFR (March 24, 1980).

are still in existence.[74] Abramova's notes indicated severe hemorrhagic meningitis in a patient who died on approximately the sixth day of the epidemic.[75] The notes detailed that

> All forty two cases were characterized by the most prominent and consistent lesions of hemorrhagic thoracic lymphadenitis and hemorrhagic mediastinitis... The pulmonary portal of entry was further emphasized by the presence of a primary anthrax pulmonary focus—focal hemorrhagic, necrotizing anthrax pneumonia in eleven patients.[76]

Despite the existence of disease in the victims' gastrointestinal tracts, Abramova and other doctors treating victims began to take note of symptoms that were asymptomatic to gastrointestinal anthrax. Though other forms of anthrax infection were rare, Abramova and others believed that the pathogenesis of the anthrax infections was pulmonary anthrax.

2. Sverdlovsk Anthrax Infectivity

In addition to clues on the Sverdlovsk anthrax outbreak's pathogenicity, by understanding the details of any agent's infectivity levels, and grasping the details of the infectivity levels of anthrax, vital epidemiological clues about the anthrax outbreak at Sverdlovsk were deciphered.

The Sverdlovsk epidemic's vital statistics—detailing the actual total number of cases, case fatality rate, and incubation period—were revised and debated for years, as a direct result of a prolonged KGB cover-up of the outbreak.[77] As a result, no actual data on the infectivity levels of the anthrax that was released in Sverdlovsk is known to exist. However, the amount of anthrax released in the outbreak was estimated at seventy kilograms (154.32 pounds), and that amount could infect the occupants of a region spanning tens of thousands of square miles.[78]

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[74] Abramova, "Pathology of Inhalation Anthrax in 42 Cases from the Sverdlovsk Outbreak of 1979," 2291.

[75] Ibid.

[76] Ibid.

[77] Holmes, *Plagues, and History: The Story of Anthrax*, 184.

[78] Guillemin, *Anthrax: The Investigation of a Deadly Outbreak,* 9.

The details of the Sverdlovsk anthrax outbreak's infectivity levels will be discussed more at length when the incubation period of the Sverdlovsk anthrax outbreak is discussed below.

3. Sverdlovsk Anthrax Virulence

Another epidemiological characteristic that led to the proper attribution of the Sverdlovsk anthrax outbreak was the outbreak's virulence. Published reports on the epidemic's vital statistics and case fatality rates have varied. Some reports suggest that there may have been as many as 250 cases, with 100 deaths, while others claim that 358 people became ill with forty-five deaths.[79] Despite the inconsistencies, the most widely accepted reports state that sixty-four people died and ninety-six people were infected. These smaller figures, alone, would have *tripled* the USSR's yearly average morbidity from anthrax and pushed its death rate off the chart. [80] The fact that this outbreak would have been exceptionally more virulent than most other anthrax outbreaks in contemporary Sverdlovsk history, was a major red flag that the epidemic was, in fact, not a natural outbreak from infected meat. Before coming clean, the Soviet government, in fact, did not have an official explanation for why the number of victims in the 1979 outbreak was exceptionally high. They continued, however, to advance their official lie that the source of the attack was merely infected meat.

4. Sverdlovsk Incubation Period

As stated earlier in this chapter, it is often the incubation period that provides the most solid forensic evidence that ultimately leads to a successful attribution of an outbreak or potential attack. In the Sverdlovsk outbreak, it was the epidemiological characteristic of the incubation period of aerosolized anthrax that eventually provided enough evidence to unearth the truth about what happened to the sixty-four people that died in Sverdlovsk in April and May of 1979.

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[79] Holmes, *Plagues, and History: The Story of Anthrax*, 184.

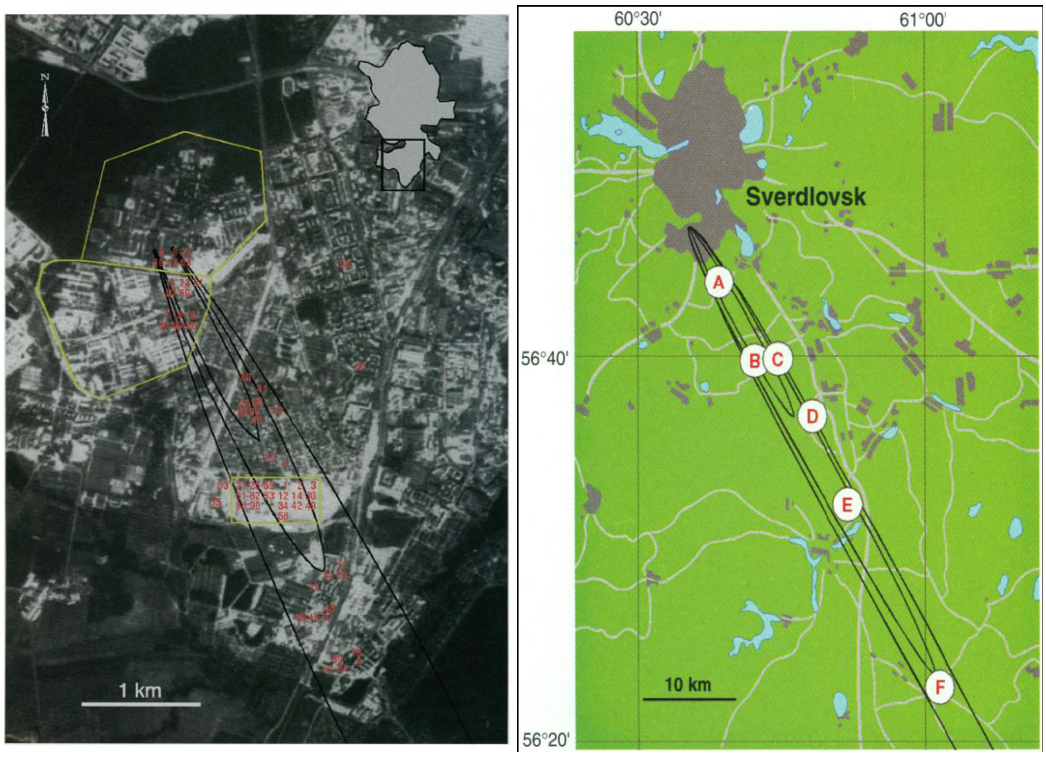
[80] Guillemin, *Anthrax: The Investigation of a Deadly Outbreak*, 34.

One can usually find that a plot of the incubation period for persons exposed at the same time follows a normal log distribution, and times and places of infection for each casualty can be reliably deduced. The series of forty-two autopsies in the Sverdlovsk cases demonstrated a striking illness affecting previously healthy persons, who died usually one to four days after infection.[81] Most importantly, however, after enough hard data was able to be collected, a very telltale pattern began to emerge that detailed exactly when and where each victim of the outbreak must have come in contact with the aerosolized bacteria. Such spot maps, retroactively pinpointing the location where each victim fell ill, is an integral part of all BW attribution investigations. According to reports collected from American scientists after visiting Sverdlovsk in 1991,

> We have now circumscribed the time of common exposure to anthrax. The number of red dots we can plot on our spot map places nearly all of the victims within a narrow plume that stretches southeast from Compound 19 to the neighborhood past the ceramics factory…What we know proves a lethal plume of anthrax came from Compound 19 (See Image 2 (a) and 2(b)).[82]

[81] Abramova, "Pathology of Inhalation Anthrax in 42 Cases from the Sverdlovsk Outbreak of 1979," 2291.

[82] Guillemin, *Anthrax: The Investigation of a Deadly Outbreak*, 233-234.



(4A) *(4B)*

Image 2. (A) Probable locations in Sverdlovsk of where victims of the anthrax outbreak were first exposed to the bacteria. (B) Villages in and around Sverdlovsk that had developed animal anthrax cases in April 1979.[83]

The spot map, coupled with scientific data on the wind patterns during the suspected beginnings of the outbreak from 2 to 6 April 1979, detail the vital need to understand an agent's epidemiological characteristics; the epidemiological data, depicted above on the dot maps, show that victims of the Sverdlovsk anthrax outbreak lived and/or worked in a narrow zone extending from a mysterious military facility—Compound 19—to the southern city limit.[84]

After many other developments—which will be discussed in subsequent chapters—and over twelve years of political accusations and lies, it was the epidemiological evidence of the Sverdlovsk anthrax's incubation period, as well as other epidemiological details of aerosolized anthrax, that eventually led to the proper

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[83] Matthew Meselson, et al., "The Sverdlovsk Anthrax Outbreak of 1979," *Science* 266, no. 5188 (November 18, 1994): 1204.

[84] Ibid., 1203.

attribution of the Sverdlovsk outbreak. Despite the probability that the United States, using other sources of information, knew the true source of the Sverdlovsk outbreak, due to the inability to investigate inside the USSR, the United States could not officially declare the true source of the anthrax outbreak. It took the fall of the Soviet Union and twelve years of time between the beginning of the epidemic and the proper attribution of its source. However, armed with hard, epidemiological facts, and dots maps that showed when and where each victim fell ill and on exactly what date symptoms began to develop, Western scientists were able to pinpoint the source of the anthrax outbreak and concretely attributed it to the accidental escape of an aerosol of anthrax pathogen from the military facility, Compound 19, in Sverdlovsk, USSR.[85] With evidence this conclusive, the Soviet government was—over time—forced to admit there was a deadly anthrax outbreak in Sverdlovsk, giving the rest of the world more insight into the Soviet's secretive biological weapons program.[86]

Because an international investigation was impossible in 1979 due to the political hostilities between the United States and the USSR, the Sverdlovsk case study emphasizes the essential role of epidemiology in pin-pointing the location and magnitude of a BW outbreak when there cannot be direct access to a BW release location. Using forensic epidemiology, Western scientists and governments were able to study, analyze, and attribute the Sverdlovsk evidence over ten years after the accident at Compound 19. Forensic epidemiology, therefore, is a critical tool for all BW investigations, and is a key component to the attribute of a BW release.

C. AMERITHRAX

The American anthrax outbreak in the fall of 2001 epitomizes both the necessity as well as the limits of sophisticated epidemiological studies in modern BW outbreak investigations. This case study emphasizes how epidemiology can help reveal essential forensic evidence in a BW investigation, but also how there is still much to be learned in the fields of forensic microbiology and epidemiology. The American anthrax

85 Meselson, "The Sverdlovsk Anthrax Outbreak of 1979," 1203.

86 See: http://www.pbs.org/wgbh/pages/frontline/shows/plague/etc/cron.html. 1992--Yeltsin admits to Sverdlovsk anthrax outbreak was caused by activity at the military facility, Compound 19.

investigation quickly revealed the weaknesses in contemporary forensic epidemiology as applied to BW investigations, and though the investigation uncovered a large amount of evidence, the epidemiological clues discovered during the investigation could only take the investigation so far. As the case remains unsolved to date, this case study shows both the strengths and the pitfalls of having to rely on epidemiological evidence to solve a BW attack.

In the weeks following the September 11th terrorist attacks, between early October and late November 2001, there was a bioterrorist attack on the United States that ran a destructive course, infecting twenty-two people with both cutaneous and pulmonary forms of anthrax, and leaving five people dead.[87] After multiple anthrax-infested letters were sent through the U.S. Postal System (USPS) to addresses in New York, Washington D.C., and Florida, an already distraught and emotionally exhausted public frantically sought medical help and advice from federal and state agencies, and desperately sought an answer as to who was responsible. Sadly, over five years have passed and what has now become known as the "Amerithrax" case remains unsolved.

Despite this sobering fact, the role of epidemiology played and continues to play an enormous role in the Amerithrax investigation. Like the Sverdlovsk case study over twenty years earlier, the role of epidemiology in the U.S. anthrax attacks assisted in narrowing the field of possible suspects and sources of the attack.

1. Strain-Level Signatures of BW Agents

An epidemiological characteristic that came to light in the Amerithrax case and not the Sverdlovsk case is that of strain-level signatures of BW agents. In biological agent species, both weaponized and natural, each separate species has its own identifying molecular marks, much like each individual has a family tree. If scientists are able to capture, analyze, and catalogue a particular species' unique molecular marks, a database can be created that identifies each strain according to its unique characteristics.

Scientists at The Center for Disease Control (CDC) and the United States Army Medical Research Institute for Infectious Diseases (USAMRIID) are among some of the

[87] The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks," *National Defense University* (November 2002), 1.

federal institutions that maintain scientific databases of potential biological weapons agents. These scientists know that each genus of bacteria has many species, and each species can have thousands of different types of strains.[88] (See Figure 1). In modern BW investigations, knowledge of an agent's strain can be the key to the eventual attribution of the attack.

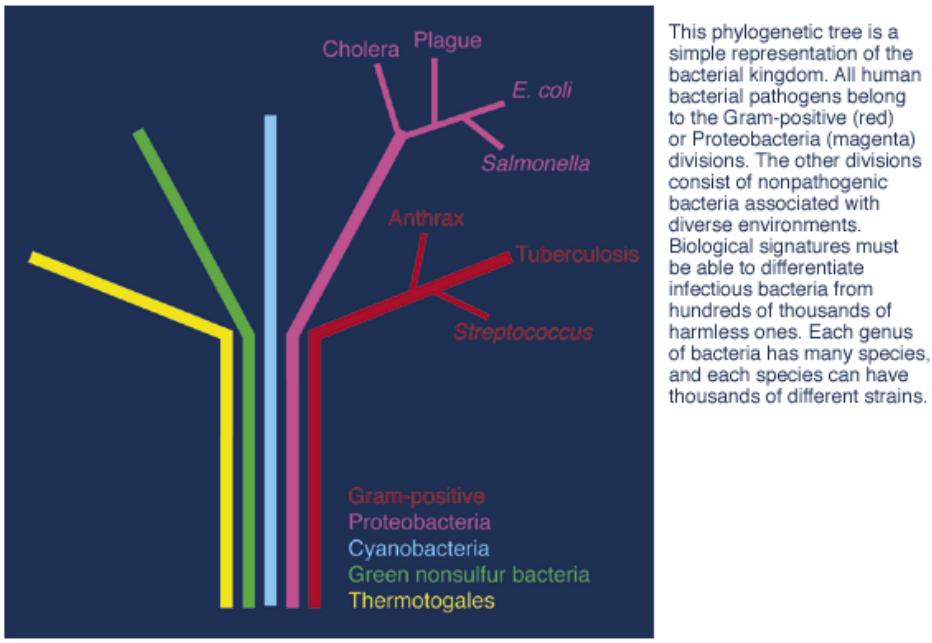

Figure 1. Phylogenetic Tree[89]

According to Bert Weinstein of Lawrence Livermore National Laboratory's Biology and Biotechnology Research Program (BBRP),

> Strains are a subset of a species, and their DNA may differ by about 0.1 percent within the species. A species, in turn, is a member of a larger related group (genus), and its DNA may differ by a percent or so from that of other members of the genus…Strain-level signatures are essential for

[88] Dr. Bert Weinstein, "Uncovering Bioterrorism," *Science and Technology Review* (May 2000). Accessed at: http://www.llnl.gov/str/Weinstein.html on March 12, 2006.

[89] Ibid.

> determining the native origin of a pathogen associated with an outbreak; such information could help law enforcement identify the group or groups behind the attack.[90]

It is precisely this technology that assisted federal efforts in identifying the strain of anthrax that was used in the Amerithrax attacks. Interestingly enough, *Bacillus anthracis* has few detectable differences among its strains.[91] There are, however, some very notable anthrax strains. For example, the anthrax strain used by the Japanese cult Aum Shinrikyo in Japan in 1993 is known to scientists around the world as the Sterne strain.[92] Additionally, the strain of anthrax created in the offensive biological warfare program of the United States before its destruction in 1969 was known as the Vollum strain. And, in 1985, USAMRIID created and tested a wild-type strain of anthrax that became known as the Ames strain, which later become infamous in the Amerithrax attacks.[93]

It was the intricacies of BW agent epidemiology and the newly developed scientific data-basing of BW strains that exposed the frightening possibility that the perpetrator(s) of the Amerithrax attacks was not a foreign terrorist, but perhaps a well-trained and educated scientist inside the United States. Early on in the investigation, after the federal government had classified the anthrax attacks as a criminal matter and not just

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[90] Weinsten, "Uncovering Bioterrorism." Researchers have, however, recognized several pitfalls with DNA sequencing techniques to identify BW strains. For example, if signatures are overly specific, they do not identify all strains of the pathogen and so can give a false-negative reading. On the other hand, if signatures are based on genes that are widely shared among many different bacteria, they can give a false-positive reading. As a result, signatures must be able, for example, to separate a nonpathogenic vaccine strain from an infectious one.

[91] Ibid.

[92] Keim, "Molecular Investigation of the Aum Shinrikyo Anthrax Release in Kameido, Japan."

[93] Thompson, *The Killer Stain: Anthrax and a Government Exposed*, 28. The Army has claimed that it had obtained the Ames strain of anthrax from the National Veterinary Services Laboratories in Ames, Iowa, in 1980, but records were sketchy. Scrutiny of the NVSL's records did not reveal an anthrax-infected cow in Iowa during that year, nor did the NVSL have a record of a strain called Ames. Now, closer inspection of Army documents has cleared up the confusion. The Army obtained the strain in 1981 as part of an effort to gather various types of anthrax to test vaccines. The strain remained unnamed until 1985, when scientists at the U.S. Army Medical Research Institute of Infectious Diseases described it in a scientific paper. The researchers named it Ames, but the strain wasn't from Iowa—it was from Texas—and a shipping container was the source of the quandary. In 1981, the Texas Veterinary Medical Diagnostic Laboratory, a state agency and member of the Texas A&M University system, isolated the microbe from a Texas cow. The laboratory shipped the strain to USAMRIID, but sent it in a special container that the USDA supplies to veterinary laboratories around the country. The container's return address was the USDA's National Veterinary Services Laboratories in Ames.

a natural isolated outbreak, scientists were able to test and analyze the strain of anthrax in the envelopes that had found their way to various location in Florida, New York, Washington D.C., and Capitol Hill. Much to the horror of the investigators involved, it was discovered that the anthrax-laced letters were filled with the Ames strain, a unique strain of anthrax used in U.S. military labs.[94] Additionally, most experts believed that only about fifty people had both the access to and the knowledge of the Ames strain and how it could be weaponized.[95] The list of possible suspects quickly turned inward, and U.S. federal prosecutors began to consider that the orchestrator of this act of bioterrorism on U.S. soil was, in fact, one of our own. The details of this investigation will be discussed in more detail in Chapter IV.

2. Amerithrax Pathogenicty

The Amerithrax anthrax attacks revealed a tremendous amount of information about the pathogenic nature of both cutaneous and pulmonary anthrax. Much of this information, unfortunately, was learned at the expense of human life. However, so few cases of pulmonary anthrax had ever occurred and had been studied in the twentieth century, that throughout the response effort, public health officials were quite forthcoming about the fact that they were facing a new situation and were learning about anthrax's pathogenic nature as they went.[96] During the outbreak, doctors, federal health authorities, and investigators learned how anthrax can actually enter and infect a host,

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[94] Thompson, *The Killer Strain: Anthrax and a Government Exposed*, 83. Arguably, some scientists insist that the strain in the Amerithrax envelopes was not identical to the Ames strain, and simply resembled an antrax strain found in western North America, more precisely Haiti, Texas, and Iowa. See The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks," *National Defense University* (November 2002), 24, 26. Notably, however, the Ames strain's origin was a cattle field in Texas, given to USAMRIID by a government laboratory in Iowa.

[95] In September of 2006, however, what was initially described as a near-military-grade anthrax was ultimately found to have had a more ordinary pedigree, containing no additives and no signs of special processing to make the anthrax bacteria more deadly, law enforcement officials confirmed. In addition, the strain of anthrax used in the attacks has turned out to be more common than was initially believed, the officials said. See Allan Lengel and Joby Warrick, "FBI Casting Wider Net in Anthrax Attacks," *Washington Post* (Sept. 25, 2006), A1. http://www.washingtonpost.com/wp-dyn/content/article/2006/09/24/AR2006092401014.html, Accessed on March 5, 2007.

[96] The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks,"), 4.

and this knowledge will undoubtedly assist the government to better prepare and protect the American public if another anthrax attack were to occur.

With multiple cases of anthrax appearing as result of anthrax-laced letters, immediate governmental and investigative response attention in the Amerithrax case was turned to the U.S. Postal Service (USPS). In fact, at the height of the outbreak, U.S. Postmaster General John Potter went to the U.S. Postal Service's Brentwood facility, which unknowingly filtered and delivered a few of the anthrax-laced letters to their addressed destinations on Capital Hill, to try to assuage its 2,400 postal workers that their fears of being infected were very minimal. Potter and his executives had consulted with expert doctors at CDC, as well as the D.C. Department of Public Health, and the CDC's top infectious disease specialists had concluded that there was no reason to start the Brentwood employees on preventive antibiotics.[97] Due to previously conceived understand about anthrax's pathogenicity and past knowledge about how anthrax can actually travel and infect a host, the CDC felt that none of the USPS employees were at risk. According to a statement in mid-October 2001 by Deborah Willhite, USPS Senior Vice President for Government Relations and public policy,

> [The CDC] says there was virtually no risk of any anthrax contamination in the [Brentwood] facility, that without the letter being opened at Brentwood, there was no risk of any anthrax escaping, so neither the facility nor the employees needed to be tested [for anthrax exposure and/or infection].[98]

Unfortunately, it had never occurred to the USPS Board of Governors, nor the expert doctors at the CDC, that refined anthrax could actually seep through the pores of a standard envelope, potentially infecting not only the person who opened the envelope, but the hundreds of people who could have come in contact either with the letter itself, or even the bags used to carry and sort the letter, or even the giant postal sorting machines.[99]

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97 Thompson, *The Killer Strain: Anthrax and a Government Exposed*, 129.

98 The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks," 31.

99 For a very interesting mathematical representation of the number of victims a single anthrax-filled envelope could claim once an envelope is passed through the U.S. mail system, see Glen Webb and Martin Blaser, "Mailborne Transmission of Anthrax: Modeling and Implications," *Proceedings of the National Academy of Sciences of the United States of America* 99, no. 2 (May 14, 2002), 7027-7032.

The Amerithrax attack revealed to the CDC and the American public that, due to the pathogenic nature of powdered, aerosolized, and weaponized anthrax spores, a single anthrax-laden envelope possessed the possibility of infecting hundreds in its wake.

Ironically, scientists at DRDC Suffield, a Canadian government facility operated by Defense Research and Development Canada, had sent a September 2001 study to the CDC's Laboratory Response Network (LRN) on October 4, 2001, the day the first anthrax letter surfaced.[100] The Canadian researchers tried to inform the CDC that their study had concluded that the aerosol released from an anthrax-laced envelope would quickly spread throughout a room so that many other workers, depending on their exact locations and the directional air flow within the office, would most likely inhale lethal doses of the bacteria. Additionally, envelopes with open corners not specifically sealed could pose a serious threat to those in the mail handling system.[101]

Both a USPS Service Center in Brentwood, as well as one in Trenton, New Jersey, had unknowingly handled, sorted, and delivered many of the anthrax-laced letters. As a result of the lack of government and medicinal understanding of the pathogenicity of anthrax, Thomas Morris Jr. and Joseph Curseen, two U.S. postal employees at the Brentwood facility, died of pulmonary anthrax. Hundreds of other postal workers tested positive for anthrax exposure, and some became infected with cutaneous forms of anthrax from handling infected mail. If federal authorities had had a better understanding of the pathogenic nature of aerosolized anthrax, these lives could have been saved, and the panic that erupted due to these letters could have been assuaged.

3. Amerithrax Infectivity

Once it was discovered that anthrax spores could actually seep through sealed envelopes and infect anyone who handled the envelope, the Amerithrax case uncovered another alarming lesson in epidemiology of BW agents: the frightening possibility of cross-contamination. Remembering that infectivity is the minimum number of infectious particles required to establish an infection, many federal and local authorities were

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100 Thompson, *The Killer Strain: Anthrax and a Government Exposed*, 136.

101 B. Kournikakis, et al.,, "Risk Assessment of Anthrax Threat Letters," *Defense Research Establishment Suffield, Report No. DRES-TR-2001-048* (September 2001).

focusing on the mini-epicenters where anthrax-laced letters were surfacing for signs of infection—the Trenton and Brentwood U.S. Postal Service Centers; Senator Dacshle's office in Washington D.C.; the AMI Media Company in Florida, etc. Authorities scoured buildings where letters were found, and tested all employees and people within the immediate vicinity of an infected letter, building, or an already infected person.

As noted earlier in this chapter, it takes roughly 2,500 spores to become infected with pulmonary anthrax, and a lethal dose of 10,000 spores can be inhaled in one breath. Doctors and scientists had assumed a person must be exposed to a minimum number of spores in order to become infected, and an even higher concentration of spores in order to die from the bacteria. Before the Amerithrax case, what authorities were unprepared to confront was that for some victims of the attacks, the infectivity threshold for infection and/or death was much lower. The scientific understanding of the capabilities of weaponized anthrax was being redefined as the investigation waged on. Scientists and government experts were literally learning on the fly, and their previous understandings of weaponized anthrax and how it could infect a person was constantly changing over the course of the investigation as new details and evidence was being uncovered.

In New York City, where anthrax-filled letters had reached the offices of ABC, CBS, and the New York Post—examples of merely a few of the places in New York City where anthrax traces were found—Kathy Nguyen, a sixty-one year old Vietnamese refugee, inexplicably became another victim of the anthrax letters. Nguyen lived alone in the Bronx, and worked at the Manhattan Eye, Ear, and Throat Hospital on the Upper East Side.[102] She commuted to work every day on the New York City subway system, and her job stocking the operating and recovery rooms in the hospital did not involve opening mail.

Nguyen's case quickly emerged as everybody's worst epidemiologic nightmare.[103] She was not in any way connected to any of the previous victims of the anthrax attacks in New York City, and in no way had ever directly come in contact with any of the contaminated letters that had been sent to the city's various media outlets.

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[102] Thompson, *The Killer Strain: Anthrax and a Government Exposed*, 184.

[103] Thompson, *The Killer Strain: Anthrax and a Government Exposed*, 162.

After tests conducted by the CDC, Nguyen's apartment yielded no sign of anthrax, and no spores were reported at her work place. It remains a complete mystery as to how and where Kathy Nguyen contracted the pulmonary anthrax bacteria that killed her.

Equally as alarming, just days before Nguyen began displaying symptoms of pulmonary anthrax, a New Jersey women who worked as a bookkeeper for an accounting firm had been diagnosed with cutaneous anthrax.[104] After a thorough inspection of the woman's workplace, no traces of anthrax had been found. Additionally, in late November 2001, a ninety-four year old Connecticut woman, Ottie Lundgren, became the second victim—after Nguyen—to inexplicably die from pulmonary anthrax. Dozens of samples from the postal facilities that handled Lundgren's mail, samples from her mailbox, and eighteen samples taken from her house and garbage all turned up negative for the presence of anthrax.[105]

Both Nguyen, Lundgren, and the New Jersey woman's case illuminated two horrifying and previously unconsidered scenarios in the Amerithrax case: that the nascent path of anthrax infection had moved beyond media companies, government offices, and mail routes and on to ordinary citizens, and that due to varying factors, authorities must now plan for scenarios in which the infectivity thresholds of some citizens is much lower than doctors had originally calculated for the general population.[106] It seemed thousands more were at risk of infection from anthrax than previously suspected.

After Nguyen and Lundgren's death, senior officials of the Department of Health and Human Services announced that some tens of thousands of letters processed through the U.S. Postal Service might have been contaminated with trace amounts of anthrax spores merely by coming into contact with intentionally poisoned mail.[107] The scenario of cross-contaminated mail and unconnected victims falling ill revealed that the medical

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[104] Michael Powell and Ceci Connolly, "New York Worker's Anthrax Deepens Mystery," *Washington Post* (October 31, 2001), A01.

[105] The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks," 64.

[106] It is important to remember that *Bacillus anthracis* is not a communicable disease; meaning, it will not spread from person to person, and only those who come in direct contact with the bacteria have the possibility of becoming infected.

[107] Eric Lipton and Judith Miller, "A Nation Challenge: The Disease; U.S. Says Thousands of Letters May Have Had Anthrax Traces," *New York Times* (December 4, 2001).

and scientific communities had more to learn about the infectivity characteristics and behavior of anthrax. Kathy Nguyen in New York, Ottie Lundgren in Connecticut, and the New Jersey accountant had no known direct contact with any of the anthrax-filled letters. These three cases highlighted the fact while the LD50 for anthrax is 8,000 to 10,000 spores, far lower levels of exposure may trigger an infection, especially in those with weakened immune systems.[108] In these three cases, investigators had difficulty finding a large enough quantity of spores to cause infection, ultimately suggesting that the ages and conditions of the victims almost certainly made them more susceptible to infection through lower numbers of spores.

These three cases shed new light on the role of the epidemiological characteristic of infectivity on BW investigations, and made public health official and federal investigators aware of the fact that in BW outbreaks, literally thousands of ordinary citizens are at risk of becoming infected, regardless of how close they are to the epicenters of an attack.

4. Amerithrax Virulence

As noted above, it was discovered early on in the Amerithrax investigation that authorities—in all localities from New York to Washington D.C. to Florida—were dealing with a strain of anthrax that closely resembled the Ames strain. After this discovery, both the CDC and USAMRIID—through careful diagnostic testing—were able to determine that the strain of anthrax that was surfacing in envelopes throughout the United States had not, in fact, been genetically altered in any way.

Although USAMRIID officials noted that the anthrax spores used in the Amerithrax envelopes had been weaponized, meaning the spores were modified from their liquid suspension form to a powdered, aerosolized form, the strain itself had not been genetically modified in any way.[109] This discovery allowed investigators and medical officials to be confident that infections caused by this Ames strain of anthrax

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[108] The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks," 31.

[109] See Note 79, above, for information on later discoveries that the perhaps the anthrax strain had not, in fact, been weaponized.

were, in fact, treatable with antibiotics.[110] As mentioned above when discussing the aims of the USSR's covert biological warfare program, certain BW programs were able to genetically modify strains of certain viruses and bacteria to create chimera viruses that resist common vaccines and are much more virulent than the naturally occurring agent.[111] Other BW programs had developed a strategy for hiding deadly viral genes inside some milder bacterium's genome, so that medical treatment of a victim's initial symptoms from one microbe would trigger a second microbe's growth. The strain of anthrax that was being circulated throughout the U.S. Postal System, however, closely resembled the Ames strain of anthrax, and was responsive to the same treatments, antibiotics, and vaccines that U.S. biological weapons researchers had developed in the 1980s when the Ames strain was first introduced into the offensive BW arsenal of the United States.

What this fact uncovered, therefore, was that although the strain of anthrax used in the Amerithrax attacks had perhaps been weaponized, its virulence was relatively low and predictable and responsive to treatment. In fact, the CDC reported that during the height of the outbreak, over 32,000 people had been prescribed antibiotics to guard against infection.[112] The fact that the Amerithrax anthrax had a well-understood virulence, coupled with the action of health officials prescribing antibiotics to those potentially exposed to the anthrax, could very well be testament to the very low number of deaths in the Amerithrax outbreak. Had the virulence levels of the strain of anthrax used in the Amerithrax been genetically modified in any way to be resistant to common antibiotics and vaccines, the number of deaths could have been exponentially higher. Understanding BW virulence, therefore, is critical to understanding, containing, and saving lives in a BW outbreak.

5. Amerithrax Incubation Period

Unlike the Sverdlovsk case, the incubation periods of anthrax infections yielded few clues in the Amerithrax case. For many of the victims, scientific knowledge of

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110 Thompson, *The Killer Strain: Anthrax and a Government Exposed*,119.

111 See Reference 41.

112 The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks," 54.

anthrax's typical incubation periods—in both the cutaneous and pulmonaryal forms of the disease—gave authorities clues as to precisely *when* the victims contracted the disease, but yielded few insights as to *where* the victims came in contact with the bacteria.

Juxtaposing the Sverdlovsk case with the Amerithrax case, the most alarming revelation is the role that modern globalization plays in contemporary BW outbreaks. With the transportation and mobilization of people and products occurring at an incredible rate, the Amerithrax case showed how a BW attack carried out through the U.S. Postal System could infect multiple people in multiple locations—wreaking havoc on local and federal authorities in multiple jurisdictions and causing mass panic in multiple cities—almost simultaneously. In fact, as has been well documented in the weeks surrounding the Amerithrax attacks, not only was domestic mail discovered with traces of a deadly BW agent, but mail around the world also began testing positive for anthrax.[113] In what is the greatest irony—in light of the two cases being studied in this thesis—in early November 2001, U.S. officials at the consulate in Yekaterinburg, Russia—previously Sverdlovsk, the site of the 1979 anthrax outbreak—announced that a negligible amount of anthrax had been discovered on one of six mailbags delivered to the consulate on October 25, 2001, from Washington, D.C.[114] The source of the anthrax was not established, although anthrax spores were found in the bag.

In a matter of weeks, twenty two people—residing in more than four cities over 1200 miles apart—had become victims of a BW attack.[115] After five people lost their

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[113] Other locations around the world that tested positive for anthrax around the time of the Amerithrax outbreak: *November 2001*: Lahore, Pakistan; *November 2001*: Yekaterinburg, Russia; *22 November 2001*: Chilean authorities state that U.S. officials confirmed that a letter postmarked from Zurich but bearing a return address from Florida tested positive for anthrax; officials later claim that the strain of anthrax found in the Chilean letter are indistinguishable from the strain found in NY and DC but later retract that comment and insist that the Chilean strain is not similar to the U.S. strain and is more similar to strains found in Turkey. See, "Chilean Anthrax Letter Confirmed," *BBC News* (November 22, 2001). http://news.bbc.co.uk/2/hi/americas/1671544.stm. Accessed on March 6, 2007.

[114] The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks," 53.

[115] The CDC's *Morbidity and Mortality Report* on 9 November 2001 indicated that 22 total confirmed and suspected anthrax cases had occured:10 confirmed pulmonaryal anthrax (2 FL, 1 NYC, 5 DC, 2 NJ); 7 confirmed cutaneous anthrax (4 NYC, 3 NJ); 5 suspected cutaneous anthrax (3 NYC, 2 NJ). See The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks," *National Defense University* (November 2002), 55.

lives from the Amerithrax attack, it become obvious that even with modern medical and scientific capabilities, successful BW attribution remains an incredibly perplexing problem.

D. CONCLUSION

This chapter assesses the vital importance of disease epidemiology on the successful attribution of a biological weapons attack through the lens of the case study examinations of the 1979 Sverdlovsk anthrax outbreak and the 2001 Amerithrax outbreak.

By analyzing one agent—anthrax—in detail, this chapter shows how complicated each epidemiological characteristic can be, and how important each characteristic is both independently and when examined as details of an agent's cohesive whole. Again, without a proper understanding of an agent's epidemiological characteristics, an actor or government could quite possibly fabricate the source of an attack, and absolve themselves of guilt—just as the Soviet Union did in Sverdlovsk. By attempting to convince the world that the pathogenesis of the anthrax outbreak was from infected meat, the USSR was able to claim that the source of a catastrophic outbreak of disease to naturally occurring events; this method of reasoning and action can easily be replicated today. However, by thoroughly examining the specific epidemiology of aerosolized anthrax spores, scientists were eventually able to prove that the Soviet government had, although accidentally, released an onslaught of unnatural death and destruction onto its own unsuspecting population.

In the same light, the epidemiological characteristics of the anthrax used in the Amerithrax outbreak provided critical clues to the details of the chaotic events following 9/11 and to a list of possible suspects. However, these epidemiological clues to date have not fully implicated a perpetrator.

If and when an attack occurs in which biological weapons are used, the sound analysis and understanding of disease epidemiology can successfully and expediently lead to the proper attribution of the attack, so that the perpetrator of the heinous crime can quickly face the international repercussions and consequences of such an abhorred and illegal action. Although epidemiology assisted in the eventual attribution of the

Sverdlovsk outbreak, as the Amerithrax case shows, epidemiology has its limits. The continued advancement of forensic epidemiology and microbiology is needed to make BW investigations more successful. Much has been learned about the epidemiological characteristics of many organisms, but the Amerithrax case shows that organisms do not always behave as predicted once they are produced in the form of a biological weapon. Scientists and government experts must continue to strengthen their understanding of the epidemiological capabilities of weaponized organisms so that—in the event of a BW outbreak—the investigation of the outbreak can both be safer and yield more evidence for the eventual attribution of the attack.

IV. THE IMPEDIMENTS TO BIOLOGICAL WEAPONS ATTRIBUTION IN INTERNATIONAL POLITICAL ENVIRONMENTS

A. INTRODUCTION

Between March and July 1997, a devastating outbreak of foot-and-mouth disease (FMD) occurred in pigs in Taiwan. A total of 6,147 pig farms with more than 4 million pigs were infected, and 37.7 percent of the pigs in Taiwan either died (0.18 million pigs) or were killed (3.85 million pigs).[116] The financial cost of the epidemic was estimated at US$378.6 million. Owing to the ban on exports of pork to Japan, it is estimated that the total economic cost to Taiwan's pig industry was about US$1.6 billion. Subsequent epidemiological testing on the strain of foot and mouth disease infecting the Taiwanese pigs revealed that the same strain of virus is present in China, leading to speculation that it was carried in with piglets or pork brought into Taiwan from China.[117]

In February 2005, a fast-moving case of pneumonic plague broke out in a small village in the Democratic Republic of the Congo (DRC). The plague spread so quickly that the World Health Organization (WHO) was called to assist in containing the epidemic. Bubonic plague is endemic in parts of Africa, including the DRC, but pneumonic plague—which is spread by human to human contact when the disease mutates to be airborne—occurs when the bacteria infects the lung, has a very high fatality rate and is deadly when left untreated, according to the WHO. The combination of the nature of the disease, as well as the remote location of the outbreak, caused quite an alarm for the WHO since this particular outbreak occurred in an unidentified northern mining town ravaged by conflict and cut off from humanitarian aid.[118] Additionally, in June 2006, another epidemic of pneumonic plague spread through the DRC, killing over

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116 PC Yang, "Epidemiological characteristics and financial costs of the 1997 foot-and-mouth disease epidemic in Taiwan," *The Veterinary Record* 145, no. 25 (December 1999), 731.

117 "Foot-and-Mouth Disease Spreads Chaos in Pork Markets," *FAS Online* (October 1997). http://www.fas.usda.gov/dlp2/circular/1997/97-10LP/taiwanfmd.htm. Accessed on February 12, 2006.

118 "WHO rushes to pneumonic plague outbreak in DRC," *Mail and Guardian Online* (February 15, 2005). Accessed at: http://www.mg.co.za/articlePage.aspx?articleid=197864&area=/breaking_news/breaking_news__africa/ on February 12, 2006.

100 people.[119] The WHO was called in to contain the epidemic, but officials have reported that control measures have been difficult to implement because of security concerns in the area.

In May 2006, health officials working in a remote and isolated village in Indonesia documented what they suspected as being the fourth cluster of person-to-person avian bird flu cases since the epidemic had begun in March of 2003.[120] In three years, bird flu spread to over forty countries, affecting Western and Eastern Europe, the Middle East, Africa, China, Russia, and South East Asia. (See Figure 2).

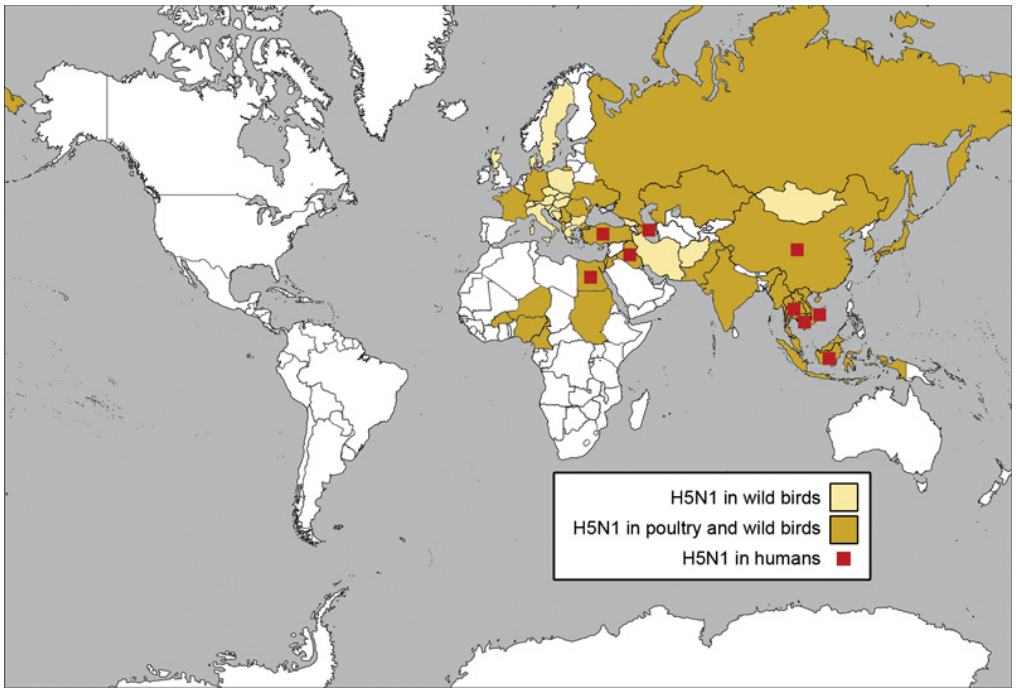

Figure 2. Nations With Confirmed Cases of H5N1 Avian Influenza (May 19, 2006).[121]

119 "Suspected plague outbreak kills 100 in DRC," *Mail and Guardian Online* (June 14, 2006). http://www.mg.co.za/articlepage.aspx?area=/breaking_news/breaking_news__africa/&articleid=274525. Accessed on February 15, 2006.

120 Associated Press, "Human spread No. 1 suspect in bird flu cluster," *MSNBC* (May 24, 2006). http://msnbc.msn.com/id/12939359/. Accessed on February 15, 2006.

121 The Emergency Email and Wireless Network. http://www.emergencyemail.org/birdflumapwang3.asp?asrcadw123=&gclid=CL3Njbqky4UCFRVzGgod2SDR2w. Accessed on January 10, 2006.

What do these three cases have in common? The pigs in Taiwan, the plague in the Democratic Republic of the Congo, and the bird flu spreading like wild-fire across the globe all highlight the intrinsic difficulties in identifying, containing, and attributing the source of a disease outbreak in an international environment. Natural disease outbreaks know no boundaries, but the organizations that monitor and investigate disease outbreaks certainly have limitations when it comes to navigating fickle international political environments. The FMD outbreak in Taiwan, for example, was wrought with very serious political accusations that China intentionally may have infected the Taiwanese pigs. Not only did the Taiwanese authorities have to contain the FMD epidemic, but a criminal investigation took place to attempt to attribute the source of the disease outbreak to a man-made source. This investigation highlights two very crucial points about biological weapons attribution. First, not only can BW cause tremendous harm to humans, but also to plants and animals. Secondly, the consequences of BW use cannot simply be quantified in numbers of sick or killed; BW use can have tremendous economic and political impacts, as well.

The plague outbreak in DRC highlights the difficulties for world health bodies to intervene, quarantine, and eradicate naturally occurring diseases in isolated, conflict-ravaged areas of the world. It also reveals how vulnerable these same areas would be if a BW agent was released on an unsuspecting population. Not only would it be difficult for health authorities to determine whether an outbreak was natural or unnatural in the isolated villages in DRC, but it is quite possible that local governments and authorities would be hostile to any outside intervention in their sovereign territories.

The bird flu pandemic represents the weaknesses in cross-border quarantines. Even if the WHO and other international organizations can track outbreaks and suggest to local authorities how to contain and/or eradicate diseases from certain areas, the inability for non-governmental organizations (NGOs) such as the WHO to legislate and enforce pandemic laws within sovereign territories may be crippling to the overall containment of the disease.

1. Roadmap

This chapter highlights the extreme difficulties U.S. and world authorities face when attempting to attribute the intentional use of a biological weapon in a foreign territory. In essence, the ability to successfully attribute an international BW attack comes down to two things: law and politics. This chapter delves deeply into the nuances of both and their effects on BW attribution.

Distinguishing between a natural and an unnatural outbreak can sometimes be an enormous undertaking due to epidemiological complexities as well as domestic jurisdictional restrictions. Disease outbreaks at an international level, however, combine the hurdles of epidemiological analysis and domestic restraints, and combines them with the at times incredibly restrictive effects of international political environments. Due to the intrinsic weaknesses in the major treaty governing biological weapons, the Biological and Toxin Weapons Convention (BTWC), the international community has very little legal ability to overtly investigate and therefore attribute an unnatural outbreak of disease. This chapter discusses at length the weaknesses of the BTWC and how the lack of a verification protocol significantly impacts the ability to attribute BW outbreaks. Additionally, this chapter discusses how the burden of proof is on a crippled international community when it comes to criminal investigations of BW use. It highlights the tools the international community possesses when it comes to international BW investigations, and detail the capabilities the international community lacks in international BW investigations. Next, this chapter discusses the impact of international politics, and the paralyzing affect states' conflicts of interest can have on international BW investigations and attribution. Aside from the epidemiological difficulties of investigating and attributing an unnatural outbreak of disease, in the end, the absence of strong legal mechanisms, as well as fickle international politics, may be the biggest attribution hurdles for the international community in international BW outbreaks. Lastly, this chapter addresses the Sverdlovsk case study to assess the international impediments to international BW attribution that existed in 1979, and sadly, still exist today.

B. INTERNATIONAL LEGAL IMPEDIMENTS TO BW ATTRIBUTION

1. Weaknesses of the Biological and Toxin Weapons Convention

The 1972 BTWC is the most important international tool against the use and development of biological weapons (BW). The BTWC is, by no means, however, a flawless treaty, and many of its weaknesses severely limit the ability to successfully attribute a BW attack. A flaw in the treaty is that no where within its fifteen articles is the actual use of biological weapons ever explicitly outlawed. The treaty only explicitly bans the development, production, stockpiling, acquisition, and retention of biological and toxin weapons; the treaty simply implicitly bans the actual use of biological weapons.[122]

Since its entry into force in 1975 there have been confirmed cases in which states have breached the Convention and several unconfirmed allegations of states maintaining offensive biological warfare programs.[123] This has resulted in increased calls from the international community to equip the members of the convention with instruments to verify and enforce compliance of the convention's mandates. To date, however, efforts to strengthen the BTWC by means of a supplementary legally-binding protocol have failed.[124] As a result, the very treaty that was put into force over thirty years ago to aid and protect the international community from biological weapons development now serves as one of the largest international impediments to the successful attribution of BW use in a foreign territory.

a. Article Four Weakness: Lack of Verification of Treaty Compliance

One of the biggest weaknesses of the BTWC, which significantly impacts the ability to successfully attribute BW use, is the treaty's lack of any binding verification

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[122] Although the BTWC does not explicitly outlaw the use of biological weapons, the 1925 Geneva Protocol does explicitly outlaw the use of BW. Although the Geneva Protocol was signed in 1925 and entered into force in 1928, the United States did not ratify the Protocol until 1975. See Milton Leitenberg, *The Problem with Biological Weapons* (Stockholm: The Swedish National Defense College, 2004), 68.

[123] The Secretary General of the UN has launched investigations into the alleged offensive BW production and/or use in Afghanistan and Indochina (1981 and 1982); Iran (1984-186, 1988); Iran and Iraq (1986); Iraq (1988 and 2002); Mozambique and Azerbaijan (1992). There have also been unconfirmed reports that Israel maintains an offensive biological warfare program.

[124] See also Chapter IV of this thesis for more information on the U.S. role in implementing additional BTWC Protocols.

measures. At four pages, it is astonishing to think that the BTWC was the first international agreement since World War II that banned the possession of an entire class of weapons.[125] The brevity of the document, however, reflects the incredibly intense political environment in which it was created in 1970. With the Cold War in full swing, the BTWC's provisions for verification were purposely written very weakly to assuage the Soviet Union. Many Western authorities in the international community at the time felt it would be better to have some sort of treaty against the use of biological weapons than no treaty at all. These same authorities knew, however, that no treaty covering a major WMD would be worth the paper it was written on if the Soviets did not sign on. As a result, the rigidity and effectiveness of the treaty's protocols were compromised to reach an initial consensus. Thirty years later, however, those compromises have proven to all but cripple the mandates in the BTWC.

(1) Legal Short-comings of Weak International Treaties and their Impact of BW Attribution. Article Four of the BTWC insists that each nation must police its own country to ensure treaty compliance.[126] State parties are required by Article Four to adopt any national measures necessary, in accordance with their constitutional processes, to prohibit and prevent the banned activities detailed in Article I of the treaty. The treaty does not prescribe the type of measures that should be adopted, although Article Four provides that such measures must be adopted in accordance with the state's constitutional process, which usually dictate how international law obligations are incorporated into national law.[127]

As is well known, there are many types of legal systems throughout the international community. According to the BioWeapons Report of 2004,

> Differences have emerged with regard to practice between states with a common law tradition and those with a civil law tradition. Common law states require national legislation to transform international obligations into enforceable national law. States parties with a common law tradition have generally determined that the Article FOUR obligation to put in

[125] Mangold, Tom and Goldberg, Jeff *Plague Wars* (New York: St. Martin's Griffin, 1999), 59.

[126] Mangold, *Plague Wars*, 59.

[127] Bio Weapons Prevention Project (BWPP), BioWeapons Report 2004, 14. Accessible at: http://www.bwpp.org/documents/2004BWRFinal_000.pdf. Accessed on December 12, 2005.

> place national measures to 'prohibit and prevent' violations of the treaty's core prohibitions requires the enactment of legislation and, specifically, penal legislation that details offences and establishes appropriate penalties for activities banned under Article I. States with a civil law tradition, however, may consider treaties they have joined as self-executing, whereby the text of the accord is automatically incorporated into national law when the agreement enters into force—no additional national measures are necessary to give it effect.[128]

A significant problem emerges, therefore, when one realizes that—because the original architects of the treaty wanted it to remain ambiguous in its implementation measures so that the Soviets would sign on—Article Four does not specify criminal offenses or define the nature of punishments if the treaty is violated. Therefore, civil law states will not be able to effectively enforce all BTWC obligations in their respective national jurisdictions without specific implementing legislation. While violations of the prohibition against the use of biological and toxin weapons might be capable of prosecution under states' laws against manslaughter or murder, the related offences of development, production, stockpiling and transfer of such weapons might not be available in states' penal codes, leaving the state unable to prosecute and punish alleged offenders.[129]

In the United States and its common law systems, for example, additional laws and federal statues had to be passed in order to make any threatened use of a disease causing organism directed at humans, animals, or plants a crime.[130] In addition, as a result of a change in the Bioterrorism Weapons Anti-Terrorism Act contained in the USA PATRIOT Act of 2001 and codified in Title18 USC §175(b), knowingly possessing a biological agent, toxin, or delivery system which cannot be justified as prophylactic, bona fide research, or other peaceful purpose can result in arrest, prosecution, and fines and/or imprisonment for up to ten years. This new provision shifts the burden of proof onto the person or persons who are in possession of dangerous biological agents to prove they have the material for legitimate purposes. Despite the

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[128] BioWeapons Report 2004, ibid.

[129] BioWeapons Report 2004, 15.

[130] Title 18, U.S.C. § 2332[a].

gains the United States made in passing such laws, in accordance with the commitments made when the United States signed and ratified the BWTC in March of 1975, it is discouraging to realize that twenty-six years and a major biological weapons attack on U.S. soil had to first occur before the United States took the BTWCs mandates as just that—mandates. Many other state signatories of the BWTC have yet to adopt additional domestic legislation to ensure the Convention's mandates are upheld.

The short-comings of the BTWC creates numerous problems in the international environment, and not only drastically reduce the international community's legal and technical ability to attribute a BW attack, but also reduces states' capabilities of credibly deterring BW use by a state or non-state actor. Thirty years after the adoption of the BTWC, some state parties have yet to adopt national criminal legislation to ensure that the BTWC mandates are being effectively carried out and followed within their own sovereign territories.

b. Article Six Weakness: Provides Incentive to Cheat

Article Six of the BTWC states that any nation that suspects another nation of breaking its treaty obligations can submit a formal complaint with the United Nations. Any accused nation is supposed to allow the UN to investigate any allegations of noncompliance. However, the BTWC provides no formal procedures, reporting requirements, or recommended sanctions and/or punishments in the instance that a state is suspected of being in violation of the treaty. Article Six, therefore, is a completely meaningless sanction.[131] The BTWC lacks any substantial checks and balances; state signatories know that renegade states have an incentive to cheat and ignore their treaty obligations because of the extremely high burden of proof any country or international body would face in attempting to prove and attribute the use of a BW agent. And as the introduction to this chapter highlights, outbreak of diseases occur frequently around the globe, and at times it can be extremely difficult to discern between a natural and an unnatural outbreak of disease. The weaknesses in the treaty create what some state

131 Mangold, *Plague Wars*, 59. Article Six expressly states that a formal complaint can be lodged with the Security Council of the UN, and an investigation can take place "in accordance with the Charter of the United Nations."

signatories feel is an ability to cheat under the cover of the treaty. Proof of this ability to cheat are the numerous countries suspected of maintaining an offensive BW program, even after becoming signatories of the BTWC, including but not limited to: Iraq, South Africa, and Russia.

Attribution will remain an extremely difficult step in international BW investigations if international protocols, legislations, and treaties are not significantly overhauled and enforced. As will be discussed below, without the legal structure in place for an international investigation to take place, the chances of successfully attributing a BW attack significantly decreases. Additionally, even if a state or an international body were to be able to accurately attribute an international BW incident, without the proper international legal mechanisms and protocols in place, those responsible for the use of biological weapons cannot be held accountable. As shown in Chapter I, if state or non-state actors know that they can acquire and use BW without fear of identification or reprisal, they—and other—states will continue to proliferate, acquire, and use BW; no actor will be deterred from such behavior because there is no fear of truly being caught.

2. International Community's Burden of Proof

As detailed in the introduction to this chapter, investigations of *natural* infectious disease outbreaks are very common, and the results of such investigations are often published. Despite this, however, surprisingly little has been written about the actual procedures followed during such domestic and international public health investigations. Most epidemiologists and public health officials learn the procedures of investigating natural disease outbreaks by conducting investigations with the initial assistance of more experienced colleagues.[132] Natural health outbreak investigations involving public health officials usually follow an inductive approach, with overall evidence being held to a standard of scientific peer review, and findings being published in scientific journals. Additionally, must public health disease investigations focus on environmental sampling of disease outbreaks, rather than forensic sampling of crime scenes were a disease

132 Arthur Reingold, "Outbreak Investigations: A Perspective," *Emerging Infectious Diseases* 4, no. 1 (January-March 1998).

outbreak of a weaponized agent has occurred. The stark contrasts between these two types of investigations will be discussed more in Chapter V.

Perhaps one of the most difficult hurdles the international community faces when attempting to attribute the release of a biological weapons agent is the legal and technical issue of burden of proof. Not only must public health officials be involved in unnatural outbreaks, but law enforcement officials must also be heavily involved in the investigations of a suspected BW outbreak. BW investigations must take a deductive approach, and all work of law enforcement investigations must be held to very stringent legal standards of evidence that will meet constitutional standards and withstand legal challenges to obtain a conviction.[133]

In domestic BW investigations, a uniform set of laboratory protocols, based on established procedures and reagents, facilitates the introduction of test results into a court of law, thereby limiting evidentiary challenges that may result from the use of different testing methods or analyses.[134] The differing nature of the investigatory work and standards to which domestic BW investigations are held, however, can pose difficulties when local public health and law enforcement officials conduct joint investigations. Overcoming the challenges of competing domestic jurisdictions, law enforcement, and public health agencies has proven tough enough within the United States during outbreaks like the Amerithrax attacks in 2001, as will be discussed in Chapter V. One can imagine, therefore, how these jurisdictional difficulties are immensely compounded when an unnatural disease outbreak occurs, and an investigation must take place at an international level.

3. International Investigations

Unlike domestic BW investigations, the international community lacks a uniformed set of laboratory standards, significantly hindering the international

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[133] Butler, "Collaboration Between Public Health and Law Enforcement: New Paradigms and Partnerships for Bioterrorism Planning and Response," 1154. The concept of burden of proof and standards of evidence in a BW attack, however is hotly contested and varies greatly between domestic policy and forensic communities. Please see Chapter V for more information on this subject.

[134] Butler, "Collaboration Between Public Health and Law Enforcement: New Paradigms and Partnerships for Bioterrorism Planning and Response," 1154.

community's ability to limit evidentiary challenges that may result from the use of different testing methods of BW evidence.[135] As discussed earlier in this chapter, the BWTC—particularly Article Six—lacks any credible investigatory mandates, and provides little assurance that if a member state is accused of cheating, a thorough and credible investigation can take place, either proving or absolving the member state of its guilt. The inability for member states of the BWTC to investigate and attribute international BW incidents undermines the deterrent value of the BTWC, and BW arms control in general.

In lights of these sobering facts, what options does the international community have if it suspects a country of using BW? Since the BTWC was brought into force, there have been multiple international allegations of treaty violations that have launched both unilateral and multilateral international investigations. At present, there are four international mechanisms for investigating alleged BTWC noncompliance: (1) adversary investigations; (2) consultative meetings with other BTWC member states; (3) UN General Assembly investigations; and (4) Security Council meetings pursuant with the auspices of the BTWC.[136]

a. The Adversary Approach

Adversary investigations occur when one country directly accuses another country of noncompliance, and the accusing country conducts its own investigation of the breach. This approach, however, is riddled with problems, and rarely leads to the successful, unanimous attribution of a BW incident.[137] Because the investigating country

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[135] Although no world-wide standard for laboratory standards and BW evidence collection currently exists, the Laboratory Response Network (LRN), created in 1999 by the Center for Disease Control (CDC) to run a network of labs that can respond to biological and chemical terrorism, now has international labs in Canada, the United Kingdom, and Australia. Although this is a step in the right direction, the United States or any other BTWC signatory would not have the laboratory assistance if an outbreak occurred in any other country. Evidence would have to be collected and then shipped back to a credible lab, significantly affecting the credibility of the evidence.

[136] Paul G. Cassell, "Establishing Violations of International Law: Yellow Rain and the Treaties Regulating Biological and Chemical Warfare," *Stanford Law Review* 35, no. 2 (January 1983), 269. Additionally, there are measures outlined in the 1993 Chemical Weapons Convention that could assist in giving legal and technical guidance in a BW investigation.

[137] One example of an Adversary Investigation that did eventually prove to successfully attribute a BW incident was the United States accusations of an anthrax release in Sverdlovsk in 1979, as will be discussed later in this chapter.

is likely to be a political adversary of the investigated country, the investigation will likely be dismissed as political propaganda, and the international community may regard any evidence presented in an adversarial investigation as tainted.[138] Examples of such failed adversarial investigations include the People's Republic of China accusing the United States of using BW in the Korean War; Cuba accusing the United States of using a crop duster to induce a dengue fever epidemic in Cuba in 1981; and the Taiwan government accusing China of infecting their pork markets with foot and mouth disease in 1997, as discussed in the introduction to this chapter.[139]

In all of these cases, it is important to note that the investigations took place internally. The accusing country was accusing another member state of using BW within its own territory (for example, China accusing the United States of using BW within Chinese territory). Therefore, the accusing country was able to conduct its own internal investigation, and release its own internal review and "evidence." The inability of any of these countries' accusations to garner enough international support and credibility to launch an official international investigation merely reinforces the glaring need for international BW investigations to be conducted by an impartial investigation team.

b. Consultative BTWC Meetings

Article Five of the BWTC provides for bilateral and/or multilateral consultations between states parties should a non-compliance allegation occur, as agreed upon at the treaty's third Review Conference in 1991. The procedure was invoked in 1997, following a Cuban allegation that U.S. aircraft had caused a crop disease outbreak involving *thrips* palmi, a polyphagus pest that infects crops like cotton, cucumber, melons, and potatoes.[140] Information was sought and received from both Cuba and the

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[138] Cassell, "Establishing Violations of International Law: Yellow Rain and the Treaties Regulating Biological and Chemical Warfare," 272.

[139] For information on Cuban accusations of U.S. BW use in 1981 see "Castro Blames the CIA for Epidemic in Cuba," *New York Times* (July 27, 1981). For more information on the Taiwanese accusations of Chinese BW in Taiwan, see "Foot-and-Mouth Disease Spreads Chaos in Pork Markets," *FAS Online* (October 1997).

[140] See European and Mediterranean Plant Protection Organization, "Diagnostic Protocols for Regulated Pests: Thrips Palmi." https://www.ippc.int/cds_upload/1102695911738_pm7_03_e_1_.pdf. Accessed on March 22, 2007.

United States, and a two-day meeting was held in Geneva by state parties to hear each side's case.[141] The Cubans presented a very weak case, and presented no scientific evidence whatsoever to back up their claims. An additional failure of the meeting was that no attempt was made by the United States to initiate an internationally based fact-finding mission, and no push was made to conduct on-site investigations to collect scientific samples from within Cuba to empirically clear the United States of guilt in this matter. Although under Article Six, states parties may refer compliance matters to the UN Security Council, Cuba made no attempt to do so on this occasion.[142]

This incident between Cuba and the United States shows how states at times use the shield of the BTWC as a sword in an attempt to spread political propaganda and undermine a state's international BW credibility. These bogus claims of non-compliance also emphasize the need to conduct thorough investigations of all non-compliance claims. If the United States had initiated an international investigation in the *thrips palmi* case, it could have attained conclusive, internationally supported evidence that Cuba was simply making false claims—and Cuba's credibility, in turn, would have been the one to suffer. Mandating investigations—even into suspected bogus claims—would help deter any future false claims of non-compliance, as countries would be unwilling to sacrifice their own political credibility simply to spread false claims of non-compliance for propaganda purposes.

Such Consultative Meetings of BTWC state parties remain a weak investigatory mechanism. Each meeting must bring together all members of the BTWC, which—with 155 members—is in itself is a daunting task. Additionally, scientific evidence still must be presented to successfully and accurately attribute a BW incident,

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141 See Stimson Center, "America Accused of Violating Biological and Toxin Weapons Convention, *CBW Chronicle* 3, no. 3 (October 1997). http://www.stimson.org/cbw/?sn=cb20020113282. Accessed on January 15, 2006.

142 "Weapons of Mass Destruction Verification and Compliance: The State of Play, Challenges, and Responses," *International Security Bureau, Department of Foreign Affairs* (Ottawa: CANADA, January 2005), 39. The Cuban accusations against the United States led to a two-and-a-half page report and twelve submissions received from the various States Parties of the BTWC. The report states that, among the seven members of the Investigation Bureau and the ten other countries submitting briefs on Cuba's allegations, there were some state parties that concluded there was no causal link between the over-flight of the U.S. aircraft and the insect infestation, while there were other countries that asserted that the lack of further detailed information made it impossible to draw any definitive conclusions.

and the consultative meeting mechanism does not provide for a legal, impartial investigation. Therefore, the consultative meeting approach would face the same scrutiny of evidence as adversarial investigations; any evidence presented by the accuser will most likely be deemed incredible or pure propaganda.

c. UN General Assembly Investigations

Many state parties to the BTWC recognize the UN General Assembly as an excellent forum able to conduct impartial investigations in the incident of a member state's noncompliance with the BTWC. The UN Secretary General has presumed inherent authority under Article 99 of the UN Charter to conduct fact-finding missions to inform himself of any situation which threatens international peace and security. Additional provisional procedures as outlined in General Assembly Resolution 37/98D—passed by the Security Council in 1988 and applicable to all UN states—mandated that a list of experts be nominated by states to be available for fact-finding missions; a list of laboratories be made available to do sample analysis; and guidelines established for the conduct of missions agreed by a group of experts.[143] The UN Department for Disarmament Affairs (UNDDA) was requested to maintain the lists. The guidelines contain information on assessing whether to proceed with a particular fact-finding mission, inspection techniques and modalities, expertise that it would be useful to have on a mission and procedures for accrediting laboratories for analyzing samples. This mechanism remains available to UN member states to date, but has since tremendously atrophied. The lists of experts and laboratories were last updated in 1989. In advance of the BTWC Experts Meeting in July 2004 the UNDDA requested member states to help update them, but few ever responded.[144] Additionally, regardless of the list of experts that is supposed to be maintained by the UNDDA, the UN does not maintain a standing, permanent group of investigatory experts. An investigation team—chosen from the list of

[143] "Weapons of Mass Destruction Verification and Compliance: The State of Play, Challenges, and Responses," 34. The Secretary-General has made use of the mechanism on several occasions, in relation to alleged chemical, biological or toxin use in Afghanistan and Indochina (1981 and 1982); Iran (1984-1986, 1988); Iran and Iraq (1986), Iraq (1988); Mozambique and Azerbaijan (1992).

[144] Ibid.

impartial experts—is compiled only after an alleged BW incident takes place. This could result in critical time delays and greatly jeopardize any subsequent investigation.

(1) Lack of on-site Access. Although the UN General Assembly has conducted BW investigations in the past, the largest problem it and any country faces when attempting to conduct an international BW investigation is the inability to enter and investigate a BW incident in a country that refuses to allow the investigation team permission to enter its sovereign territory. As recognized and generally respected under international law, no state or non-state group may enter another state's territory to conduct investigations, or even provide humanitarian aid and assistance, without the explicit permission from the host country.[145] General Assembly Resolution 37/98D simply states that groups appointed by the Secretary General should undertake onsite sampling when the countries concerned cooperate and such sampling is relevant to the investigation.[146] The resolution does not explain what should happen if a country refuses access to an alleged BW site, and given the General Assembly's inability to issue authoritative orders, gaining onsite inspection will continue to be a major problem for any investigations led by the UN General Assembly.

Time is of the essence when it comes to properly being able to diagnose and attribute an outbreak of unnatural disease. The inability to both form an investigation team, as well as gain timely access to the site of an alleged international BW outbreak compromises the authenticity of evidence samples, eye witness reports and memories of the incident, and may even cause nations to become impatient with the investigation, to despair of subjecting the alleged aggressor to international disapproval and condemnation, and may result in retaliatory, unilateral action.[147]

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[145] See Ann Orford, *Reading Humanitarian Intervention: Human Rights and the Use of Force in International Law* (Cambridge University Press, NY), 2003.

[146] G.A. Res 37/98D, UN Doc. A/RES/37/98D, at para. 6(b) (prov. Ed. 1982).

[147] Cassell, "Establishing Violations of International Law: Yellow Rain and the Treaties Regulating Biological and Chemical Warfare," 275.

For all of these reasons, relying on the UN General Assembly to compile an impartial investigatory team once an illegal BW incident takes place is an insufficient mechanism of successfully attributing an international BW attack.

d. Security Council Meetings

As discussed previously in this chapter, Article VI the BTWC stipulates that any state member finding another state member to be in violation of the treaty can bring the matter before the UN Security Council. Despite there being multiple accusations by various states of noncompliance since the BTWC inception, no states has officially brought a BW use accusation before the Security Council (SC).

One could speculate that the Security Council would try to assemble an investigatory team, much like the one proposed by the General Assembly. The only advantage, however, that the Security Council possesses that the General Assembly does not is the Security Council's ability to order countries to submit to onsite inspections. Despite this authority, however, the Security Council faces the crippling motion of another SC member's veto on ordering a country to submit to onsite inspections. Therefore, for both reasons of legal and political impotency, the Security Council, itself, may not prove to be an effective vehicle for onsite investigations in international BW incidents.

With that said, there is a need for two critical things if international BW attribution capabilities is to improve at all: a permanent, agreed upon, legally binding mandate that establishes a standing international, impartial investigation team in the event of an international BW attack; and an internationally agreed upon standard of evidence and evidence handling standards. As the FAS Working Group on Biological Weapons Verification has stated,

> An effective mechanism for investigating alleged use of biological and toxin weapons will not only enhance compliance with the BTWC by deterring use, but will also assure States Parties that any suspicious incident occurring on their territory will be at their request. It will also

> offer a means by which countries wrongly suspected of violation can demonstrate their compliance, and it will discourage unfounded and destabilizing accusations.[148]

Additionally, the possibility of tense international political relationships impeding successful BW investigations reinforces the role of allies in combating WMD and protecting U.S. national security interests, both at home and abroad. Positive, preexisting relationships and positive international relations are critical to coordinating events, clinical samples, and findings in an international BW event.[149] Without friends and allies, and sound and enforceable international legal mandates, successful international BW attribution may remain unattainable.

C. AN INTERNATIONAL CASE STUDY: SVERDLOVSK

The problems the United States faced in the months after the Sverdlovsk outbreak accurately depict some of the ongoing problems of definitive attribution in an international BW outbreak. Although the Sverdlovsk incident occurred nearly thirty years ago, the hurdles to attributing that anthrax outbreak would be the same hurdles the international community would face today if a similar incident occurred.

The Sverdlovsk anthrax incident in 1979 merely confirmed what the international community had already been suspecting since the USSR signed (in 1972) and ratified (in 1976) the BTWC: the USSR was cheating. Some academics insist that the USSR's noncompliance of its BTWC treaty obligations marked the first gross violation of post-Word War II treaties, and caused a massive shift in the international legal order that has yet to shift back.[150]

Soon after the Soviets signed the BTWC in 1972, the Defense Intelligence Agency (DIA) and the Central Intelligence Agency (CIA) told the U.S. government that the Soviets were cheating on their treaty commitments, with proof from satellite spy

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[148] FAS Working Group on Biological Weapons Verification, *Report of the Subgroup on Investigation of Alleged Use or Release of Biological or Toxin Weapons Agents* (April 1996).

[149] Butler, "Collaboration Between Public Health and Law Enforcement: New Paradigms and Partnerships for Bioterrorism Planning and Response," 1154.

[150] See Federation of American Scientists (FAS), "Ten Important Events in the Past Ten Years: Shocks to the Regime." http://www.fas.org/bwc/papers/review/impevents.htm. Accessed on March 22, 2007.

photos—which, at the time, was the only available way to verify that the BTWC's mandates were being enforced.[151] Despite this evidence, the U.S. government did not want to accuse the USSR of treaty violations because the United States feared it would lose its other ongoing nuclear negotiations with the Soviets by making such accusations.[152] Additionally, without the ability to concretely investigate and prove to the entire international community that the USSR was cheating on BTWC mandates, the United States had no incentive to accuse the Soviets of violations—since paradoxically, the allegations would tarnish the BTWC treaty and instead focus attention on the treaty's lack of verification. Therefore, the treaty that was weakly constructed so as to appease a world super-power was subsequently ignored and further weakened when that same super power chose not to honor its commitments.

The Soviets chose to cheat on the BTWC for their own political reasons; the Kremlin felt the Soviets offensive biological weapons program was integral to the USSR remaining a world super-power, and saw biological weapons as a counterbalance to the ever-expanding U.S. nuclear program. The Soviets made their own political calculation when choosing to sign the BWTC—to appease and continue to deceive their international counterparts—while continuing to develop their vast offensive biological warfare program. In turn, the United States made its own strategic cost-benefit analysis that balanced contemporary international political relationships and international legal commitments. In the end, the U.S. commitment to strengthening its own proposed treaty was on the losing end of that calculation. Once the world became aware that the Soviets had been incessantly cheating on their BTWC commitments—through the Sverdlovsk accident, various intelligence reports from numerous countries, admissions from defected

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[151] Mangold, *Plague Wars*, 62. For more on the history and role of aerial imagery with BTWC treaty compliance, see Olive Meier, "Aerial Surveillance and BWC Compliance Monitoring," *Research Group for Biological Arms Control*, Occasional Paper 2 (November 2006). http://www.biological-arms-control.org/download/aerial%20surveillance_web.pdf. Accessed on March 15, 2007.

[152] Mangold, *Plague Wars*, 62. Also, according to a declassified DIA document, United States at the time did not have direct proof of Soviet biological weapons activities, though overhead imagery was apparently useful in identifying potential sites of interest. Defense Intelligence Agency: "Foreign Technology Weapons and Systems", DST 2660P-107-80-SAO, March 3, 1980.

former Soviet scientists involved in the USSR's BW program, as well as through the public admission of President Yeltsin in 1992—the BTWC was seen by many as a dead in the water.[153]

1. No On Site Access

At the height of the Cold War, there was no chance at all that the USSR would allow the United States or any other entity to enter its territory to investigate a suspected disease outbreak. Political tensions were too high, and no legal mechanisms existed to force the USSR to capitulate to an investigation. As a result, the only mechanism of evidence the U.S. government could rely on was intelligence and surveillance evidence.

Intelligence evidence, however, was not enough to indict the Soviet Union of any wrong doing. Recently declassified U.S. intelligence reports from 1979 speak of "rumors of an accident at the biological warfare institute at Sverdlovsk," but also indicate that the reports "added little to our knowledge of what actually happened at Sverdlovsk."[154] Citing its own insufficiency as legitimate evidence that a BW outbreak had occurred, the report goes on to say that "despite the proliferation of rumors of a BW-related accident, there is insufficient evidence that the alleged deaths can be attributed to unlawful storage of a BW agent."[155]

2. No Open Records

As reported by multiple sources, almost immediately after the anthrax outbreak, the Soviet government confiscated the medical records of the Sverdlovsk victims, and the current Russian government has even now refused to release data or details on what happened April 2, 1979 in Sverdlovsk.[156]

One of the only current sources of first-hand evidence of the types of injuries sustained by victims of the Sverdlovsk outbreak are the hand-written notes of Dr. Faina

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153 Mangold, Plague Wars, 62.

154 Central Intelligence Agency, "Biological Warfare USSR: Additional Rumors of an Accident at the Biological Warfare Facility in Sverdlovsk," F-1991-00146 (October 15, 1979). Declassifed June 4, 1997.

155 Ibid.

156 Dawn Levy, "Researcher Studies Old Anthrax Release for Hypotheticals," *Stanford Report* (May 17, 2006).

Abramova, who was one of the emergency room doctors treating the many patients who came into her Sverdlovsk facility after the outbreak occurred. In 1979, she risked her life and her job when she hid her patient charts and autopsy reports from the KGB. She also hid the jars of organs and tissue samples from the outbreak in her hospital's pathology museum so they would not be confiscated.[157] Without Dr. Abramova's notes, the U.S. government and academics would not have been able to build a sound, scientifically-backed case that an anthrax outbreak had, in fact, occurred in the Sverdlovsk.

The 1979 Sverdlovsk outbreak presented the United States with multiple problems and challenges of attempting to attain first-hand evidence or records that a BW outbreak had, in fact, occurred in the USSR. Sadly, there have been very few legal and political advancements made in trying to close this gaping hole in the field of BW attribution. Under current international law, the United States and/or other international organizations cannot enter a country to investigate a suspected BW outbreak unless invited to do so by the country where the outbreak occurred. Additionally, even if a state were to invite the United States or a neutral foreign entity to enter its sovereign territory to assist in a BW investigation, it is possible that the state would not allow any of the BW investigation evidence to leave the country at all.[158] A state has the right to report or not report any evidence collected in a BW investigation. The consequence of this reality is exactly what occurred in the Sverdlovsk: a state was able to deny for over twenty years that a deadly BW pathogen had killed and maimed dozens of its citizens. Without the ability to collect evidence and records of the outbreak, the international community could suspect and point fingers all it wanted; but the USSR could only be considered a suspect, and could not be classified as a perpetrator of BW use.

D. CONCLUSION

It is unsettling to think that most of the major problems that plagued the United States during the Sverdlovsk outbreak are still an issue today, nearly twenty-five years later. Due to multiple factors, including the lack of a domestic consensus on both national

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[157] Guillemin, *Anthrax: The Investigation of a Deadly Outbreak*, 70.

[158] Personal communication with Dr. Randall Murch, 18 July 2006.

and international BW defense policy, as well as the lack of agreed upon investigatory protocols for either a domestic or international BW outbreak, the United States has faced and will likely again face the same hurdles and complications in BW attribution if another outbreak were to occur.

In a Post-9/11 environment, and especially in light of the ongoing war in Iraq, Americans are very concerned about a country in illegal possession of WMD. Despite these concerns and the drastic political and military policies that these concerns led to, the United States and the world remains extremely restricted in its international BW attribution capabilities. No amount of military force or political savviness can overcome the short-comings of international law. If the United States truly wants to increase its defenses against a BW attack, the short comings of the BTWC must be addressed and corrected. As will be shown in Chapter V, however, strong and sound international law is completely dependent on the cooperation of states and national leaders. Often times, a state's domestic agenda and own internal weaknesses in BW attribution hinder any sort of consensus on what a sound international BW attribution should be. Until independent states can work out their own attribution capabilities, as mandated within the BTWC, the strength of any international treaty governing BW defenses will remain only as strong as its weakest link.

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V. THE IMPEDIMENTS TO BW ATTRIBUTION IN DOMESTIC POLITICAL ENVIRONMENTS

A. INTRODUCTION

> No matter what anybody says, if it is five years out, and we are not even seeing any smoke from the investigation, then I would say definitely that [the Amerithrax] case is cold right now…This [investigation] is just sitting out there with nothing happening.
>
> Christopher Hamilton, former FBI Counterrorism Official, speaking on September 16, 2006[159]

Over five years have passed since the Amerithrax attack of September and October of 2001. Millions of dollars and multiple national and international agencies have been involved in the investigation, and yet one of the biggest crime mysteries of our time remains unsolved.[160] In December 2006, a disgruntled Congress called on the FBI to release its information on the attacks, blaming the Bureau for the lack of progress in the investigation, and reminding the public that "all Americans deserve to know why this five-year investigation has made so little progress."[161]

Upon closer examination, however, there are multiple reasons why the Amerithrax investigation has slowed down and has not produced as many leads in the past months. As previously discussed, BTWC insists that each nation must police its own country to ensure treaty compliance.[162] This mandate was again affirmed in 2004 by UN Security Council Resolution 1540, which holds:

> [A]ll States, in accordance with their national procedures, shall adopt and enforce appropriate effective laws which prohibit any non-State actor to manufacture, acquire, possess, develop, transport, transfer or use nuclear, chemical or biological weapons and their means of delivery, in particular

159 Eric Rosenberg, "Five Years after Terror of Anthrax, Case Grows Colder," *Houston Chronicle*, 16 September 2006.

160 Ibid.

161 Associated Press, "Congress Wants Answers on Anthrax," *CBS News*, 12 December 2006. http://www.cbsnews.com/stories/2006/12/12/politics/main2252540.shtml. Accessed on March 15, 2007.

162 Mangold, *Plague Wars*, 59.

> for terrorist purposes, as well as attempts to engage in any of the foregoing activities, participate in them as an accomplice, assist or finance them.[163]

State parties are required by Article Four of the BTWC to adopt any national measures necessary, in accordance with their constitutional processes, to prohibit and prevent the banned activities detailed in Article One of the treaty, but the treaty does not prescribe the type of measures that should be adopted, although Article Four provides that such measures must be adopted in accordance with the state's constitutional process. Therefore, it is up to a nation's own domestic legislature to determine and adopt the procedures necessary to prohibit the acquisition, and implicit use, of biological weapons.

An in-depth analysis of the on-going Amerithrax investigation reveals the weaknesses of the BW policies the United States has implemented, or failed to implement, in an attempt to be in compliance with BTWC Article Four. To date, the investigation of the Amerithrax attacks has fallen victim to a bureaucratic system of governance that is still trying to refine and implement an efficient attribution capability, and one that also has yet to agree on what "BW attribution" truly is. Due to very complex technical issues, disagreements as to what a proper standard of proof to initiate a BW investigation, as well as the ongoing bureaucratic and jurisdictional issues being fought out over which government agency should be leading the charge in BW investigations, it seems unlikely that any government agency would be able to successfully conduct a thorough investigation of the Amerithrax attacks, or any future outbreak.

1. Roadmap

This chapter examines the impediments that domestic political environments have on a successful biological weapons investigation. It first examines the technical impediments to attribution in the United States, including first responder preparedness, as well as the lack of cross-agency standard operating procedures for BW investigations. This chapter then examines the jurisidictional issues of a domestic biological weapons

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[163] UN Security Council Resolution 1540, S/RES/1540 (2004), April 2004. Accessed at: http://daccessdds.un.org/doc/UNDOC/GEN/N04/328/43/PDF/N0432843.pdf?OpenElement on March 15, 2006.

investigation in the United States, and shows the stark differences in how certain agencies typically involved in a BW investigation define the end goal of attribution.

Lastly, this chapter applies the above issues to the still on-going Amerithrax investigation, to show how domestic politics and organizational constraints could quite possibly become the reason the attacks have and may remain unsolved.

B. TECHNICAL ISSUES

The first step in the successful attribution of a biological weapons attack is identifying that an attack has actually taken place. As discussed in detail in Chapter II, this step is sometimes much easier said than done, due to biological weapons unique epidemiological characteristics. The defense against a biological weapons attack involves a cadre of government communities, from the local level all the way up to the highest federal level. (See Table 3). Coordinating the interaction and information sharing between these agencies is a significant task, and has yet to be fully worked out to its most efficient capacity.

Table 3. Some of the Agencies Involved in Biological Weapons Outbreaks.

	Local	**National**	**International**
Law Enforcement	Local Police	FBI	INTERPOL; CIA: FBI, DOD, DOS
Agriculture	Local farmers and distributors.	USDA; NASD	USDA
Medical and Disease Surveillance	Local physicians and hospitals, Vets, Plant Pathologists	CDC; National Labs (LRN); NCEH	CDC (U.S.); DEFRA (U.K./EU); WHO
Government		Policy and National Decision Makers; DHHS	Diplomacy and Arms Control Communities

The first line of a country's biological weapons defense lies at the local level, and greatly depends on local doctors and hospitals being adequately trained to recognize the

symptoms of an unnatural, BW-related outbreak.[164] This ability, however, requires doctors and hospitals to continue to take state and federally sponsored classes, so physicians can remain up to date and vigilant on the possible symptoms of certain weaponized biological agents. Some BW agents—such as anthrax—can cause natural infections from natural sources. Additionally, sometimes a BW infection can closely resemble other infections, like the common flu, and may go unrecognized for quite some time. The sooner local doctors can suspect and recognize that a patient's symptoms are quite unusual and perhaps the result of a BW attack, the quicker state and federal task forces can take action to prevent the spread of the disease, but also be able to begin an investigatory attribution process.

C. ORGANIZATIONAL ISSUES

Despite the technical impediments to a successful biological weapons investigation, one of the most startling hurdles simply lies within the lexicon of attribution. Though a successful BW investigation relies on multiple agencies being able to work and coordinate their investigations in efficient unison, it is unsettling to know that most of the major organizations involved in BW attribution do not even agree on what attribution truly is. Each organization has its own role and mission in investigating a BW outbreak, and sometimes one organization's mission is in direct contradiction with another organization's efforts. Should policymakers possess the same definition and focus of attribution as forensic investigators? Should the goal of BW attribution ultimately be to bring the perpetrators of BW use to justice, so that future offenses could be deterred, as forensic investigators hoped? Or should the goal of attribution be being able to collect enough legitimate intelligence so that when BW use does occur, policymakers are able to act and/or retaliate within a matter of hours or days?

If national BW attribution efforts are to be successful, the three largest communities involved in BW investigations—the public health communities, the forensic communities, and the policy communities—must agree on what the end-goal of a BW

164 See *Public Health Emergency Response Guide for State, Local, and Tribal Public Health Directors*, Department of Health and Human Servives, Center for Disease Control. http://www.bt.cdc.gov/planning/pdf/cdcresponseguide.pdf. Accessed on March 5, 2007.

investigation must be. These organizations have made gains since 2001, but before the Amerithrax outbreaks, these major organizations' differing lexicons of attribution directly contradicted and interfered with each other's investigations.

1. Public Health Community: Epidemiology

As evidenced by the mission of the CDC, medical and public health communities' goals in the event of a disease outbreak is to protect public health, and prevent the spread of the disease outbreak.[165] This main mission of identifying and detecting that a disease outbreak has occurred greatly influences the manner in which public health agencies conduct outbreak investigations, as will be discussed more below. Through a complex system of interrelated agencies and laboratories, the public health communities focus on disease detection and epidemiological analysis to pin point the existence and location of an outbreak, and then focus on containing and eventually eradicating the source of the disease.

Because of the complex nature of the nation's public health infrastructure, not only is this community's attribution goals at times in contradiction with other communities, but even within the public health community there is a drastic variance in the manner in which outbreak investigations are conducted. In fact, there is significant state-to-state variability in the existing public health system, and also variability at the local levels. Effectively, each of the fifty states has its own detection systems since public health surveillance at the state and local level is based upon the constitutions, regulations,

[165] The CDC's main goals include working with states and other partners to provide a system of health surveillance to monitor and prevent disease outbreaks (including bioterrorism), implement disease prevention strategies, and maintain national health statistics. CDC also guards against international disease transmission, with personnel stationed in more than 25 foreign countries. See http://www.cdc.gov/about/default.htm. Accessed on March 5, 2007.

rules, and common law of each state.[166] So even within the public health community it can be challenging to coordinate who is in charge and what the overall mission is during an outbreak investigation.[167]

Additionally, although the CDC and other public health agencies are involved in covert, intentional disease outbreaks, the majority of their missions focus on environmental sampling of overt, naturally-occurring diseases. Public health agencies are extremely knowledgeable about disease causing organisms, but some are less familiar with the behaviors and capabilities of *weaponized* disease causing organisms. As such, the CDC and other public health agencies' capabilities with and investigations into disease outbreaks greatly differ during covert and overt disease investigations. Once a disease outbreak shifts from being a suspected natural outbreak, to an intentional, BW-related outbreak, the public health community relies more upon the law enforcement and forensic communities to conduct the investigation. However, both communities remain actively involved in and are critical to the overall BW investigation. (See Figure 3 and Figure 4.)

166 Michael M. Wagner et al., The Nation's Current Capacity for the Early Detection of Public Health Threats Including Bioterrorism. (Rockville, MD: Agency for Healthcare Research and Quality), September 26, 2001. For a thorough history of early and contemporary federal public health organizational structure, as well as the federal public health orgnaization's response standards in the event of national emergencies such as a BW event, see Alfred J. Sciarrino, "The Grapes of Wrath and the Speckled Monster, Part III: Epidemics, Natural Disasters and Biological Terrorism-The Federal Response," *Michigan State University College of Law, Journal of Medicine and Law*, no. 10 (Summer 2006), 429.

167 See also Bernett, Brian. "U.S. Biodefense and Homeland Security: Toward Detection and Attribution." M.A. Thesis. Monterey, Calif.: Naval Postgraduate School, December 2006.

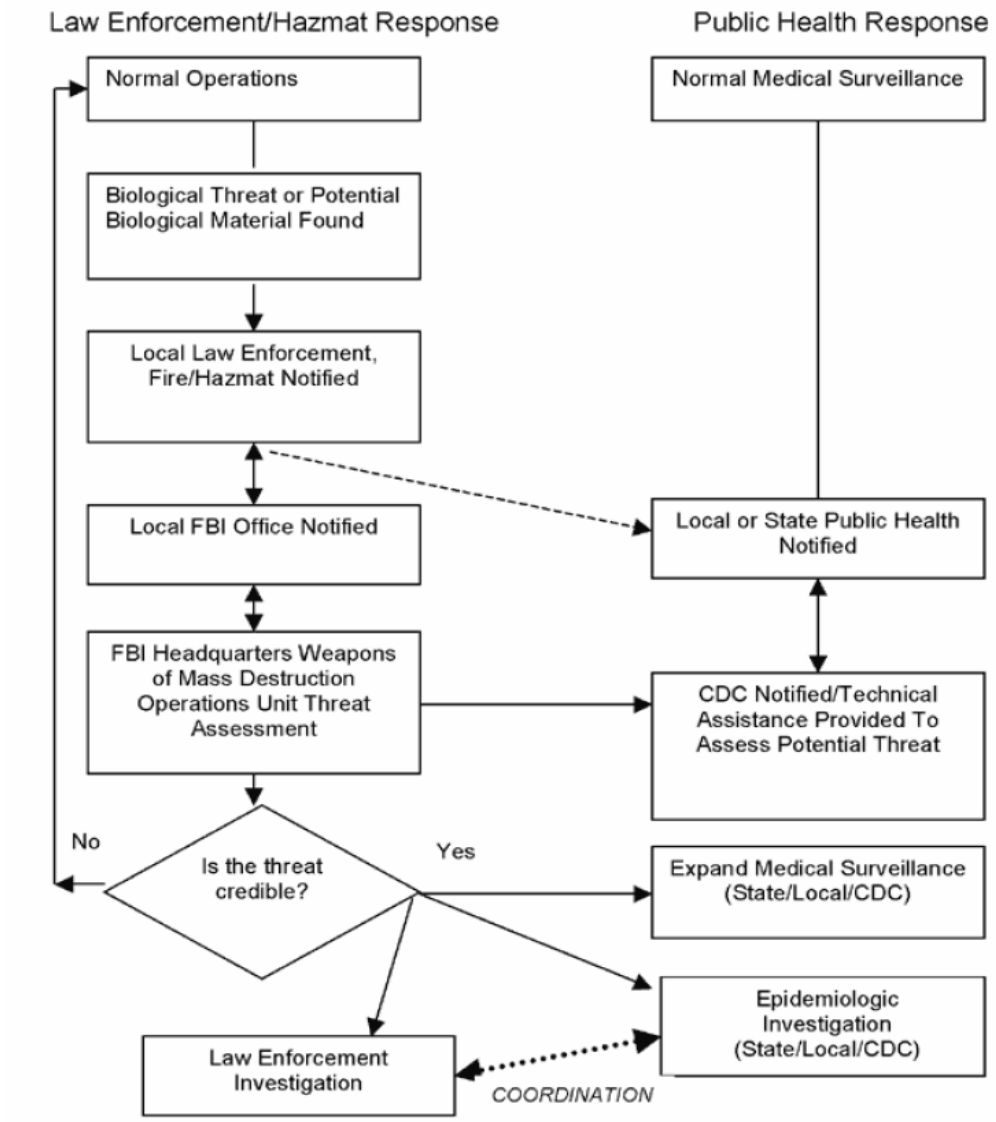

Figure 3. Likely flow of communication during overt disease outbreak in most (solid line) and some (dashed line) jurisdictions.[168]

168 Butler, "Collaboration Between Public Health and Law Enforcement: New Paradigms and Partnerships for Bioterrorism Planning and Response," *Emerging Infectious Diseases* 8, no. 10 (October 2002).

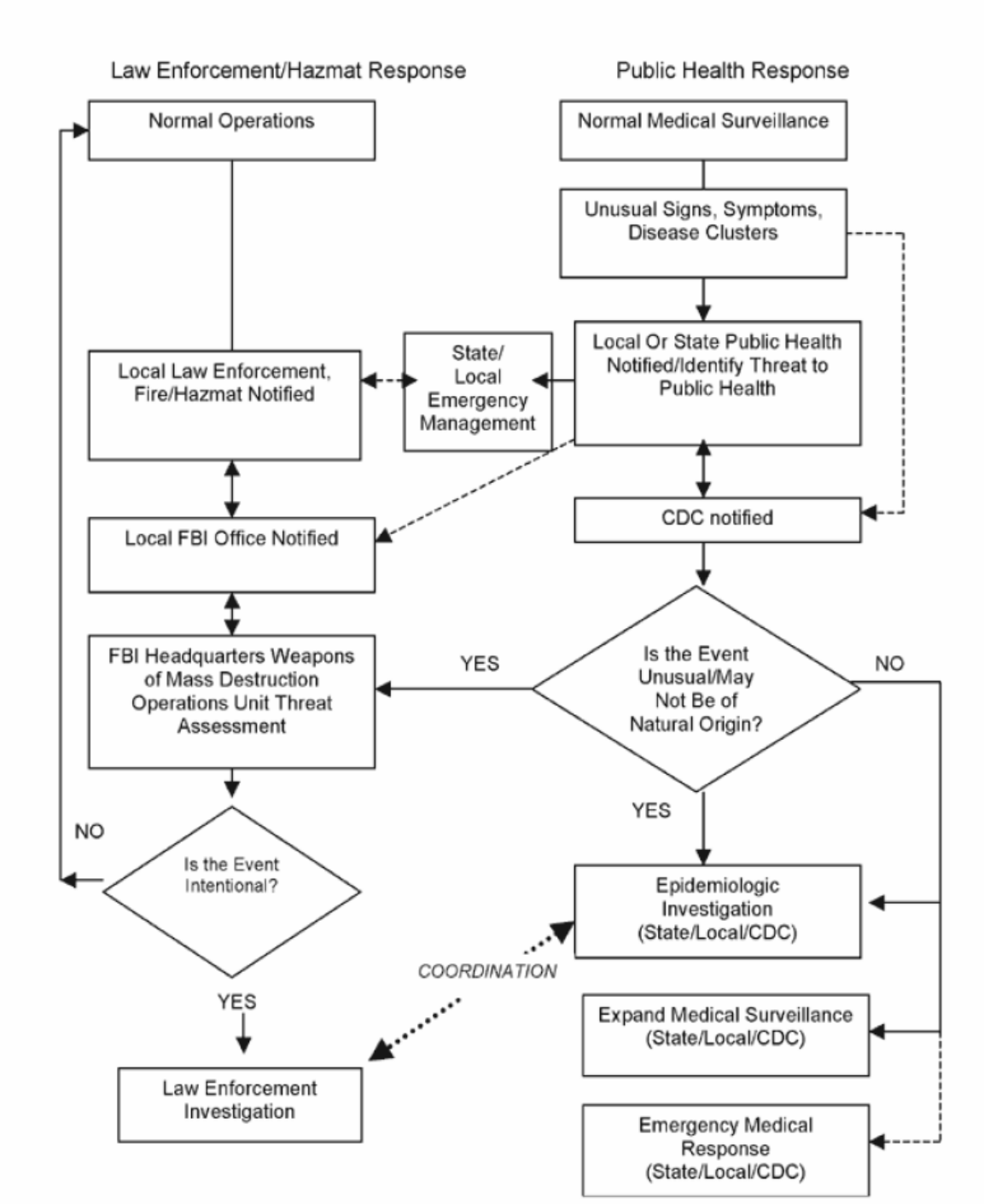

Figure 4. Likely flow of communication during covert bioterrorism in most (solid line) and some (dashed line) jurisdictions.[169]

169 Butler, "Collaboration Between Public Health and Law Enforcement: New Paradigms and Partnerships for Bioterrorism Planning and Response," *Emerging Infectious Diseases* 8, no. 10 (October 2002).

2. Forensic Community: Microbial Forensics

Another major player in an outbreak investigation is the forensics community, which includes law enforcement agencies, microbial forensics specialists from the FBI, and other national investigative agencies. Microbial forensics can be viewed as the link between the public health community's attribution aims to control a disease outbreak, and the policy community's end-goal of wanting to know who is responsible for an outbreak. The detailed break-down of BW agent epidemiology in Chapter II—detailing the importance of knowing an agent's pathogenisity, infectivity, incubation period, virulence, as well as it's possible phylogenetics—is an example of the emerging field of microbial forensics, and shows that with the continued advancement and implementation of this science, major gains in BW attribution can be possible.

For the microbial forensics community, attribution is the "assignment of a sample of questioned origin to a source of known origin to a high degree of scientific certainty."[170] Forensics integrates hard science with the investigative process, and serves as an analysis and interpretation of available physical evidence to determine its relevance to events, people, places, tools, methods, processes, intentions, and plans.[171] The end-goal for forensics attribution is not only to determine what caused a disease outbreak, but also to gather enough scientifically sound evidence to be able to identify and prosecute who it is that was responsible for the disease outbreak. This mission greatly influences the manner in which the forensics community conducts outbreak investigations, as well as the way in which the forensics community is able to share information with other organizations. (See Table 4).

[170] Randall Murch, "Biothreat (Microbial) Forensics: The Next Great Forensics Challenge," Unpublished Presentation, Spring 2006.

[171] Ibid.

Table 4. Phases of Forensics Investigations.[172]

Phases of Forensics Investigations
1. Intelligence and Information Gathering
2. Field Investigation
3. Crime Scene Investigation
4. Laboratory Analysis
5. Interpretation, Integration, Application
6. Building, Shaping Prosecution
7. Communication and Decision Making

The forensics community places the highest amount of emphasis on sample collection and analysis. The community has repeatedly cautioned that one of the biggest short-comings in BW investigations is that there remains no uniform evidence collection standards among the many agencies involved in the investigation.[173] The FBI has its own very rigorous sample collection standard operating procedures (SOPs), but the public health communities and policy communities do not abide by or follow these same SOPs. Whereas the CDC is usually entirely focused on environmental sampling, the FBI conducts outbreak investigations from a forensic standpoint, and the preservation of the samples is of the utmost importance. In fact, for the forensics community,

> [I]dentification, collection, handling, and preservation of samples prior to arrival at the laboratory are crucial to avoid compromising subsequent assays. The challenge is to preserve signatures in the sample when it is removed from the crime scene… There are no standardized microbial evidence collection kits…Evidence collection procedures need to be developed with the intent, if possible, of preserving traditional forensic evidence, such as hair, fibers, fingerprints, and human DNA, as well as providing adequate material for microbial forensic analyses.[174]

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[172] Randall Murch, "Biothreat (Microbial) Forensics: The Next Great Forensics Challenge," Unpublished Presentation, Spring 2006.

[173] Much of the information in this chapter was provided to this author through an interview in June 13, 2006 with an FBI official who has been working on the Amerithrax investigation. Due to the ongoing and sensitive nature of the investigation, the official would like to remain anonymous, and will be cited as Anonymous FBI Interview, June 13, 2006.

[174] Bruce Budowle, et al, "Toward a System of Microbial Forensics: From Sample Collection to Interpretation of Evidence," *Applied and Environmental Microbiology* 71, no. 5 (May 2005): 2209.

Although microbial forensics is a critical component in a BW investigation, it is a relatively new player on the scene. During the 1996 Summer Olympics in Atlanta, defense-experts came to the sobering realization that the United States had no national forensic program for detecting and investigating WMD.[175] As a result, forensic specialists—led by the FBI—brought together an interagency community of experts to begin creating a WMD and BW attribution capability. This interagency community combined the expertise of phlyogenetics, systematics, epidemiology, and the forensics community to create the FBI's Hazardous Materials Response Unit (HMRU).[176] Today, HMRU provides the capability to safely and effectively respond to criminal acts and incidents involving the use of hazardous materials and develops the FBI's technical proficiency and readiness for crime scene and evidence-related operations in cases involving chemical, biological, and radiological materials and wastes.[177]

Before HMRU was created, however, there was no hazardous materials response capability at all.[178] BW investigations were ad-hoc, and primarily led by the military specialists that would come in and conduct a public health-like investigation. The quality of these investigations was not thorough, and any evidence collected during such investigations was not sound enough to be used as evidence in a criminal prosecution.[179] Before the formation of HMRU, there was no civilian or forensic outreach, and the military simply used what it knew how to do to clean up any hazardous material incidents.

After the 1996 Olympics and in the wake of the Amerithrax attacks, the scientific and forensics communities realized that—in addition to an HMRU—there was an immediate need for a laboratory organization that could perform microbial forensics analyses in the wake of bioterrorism event.[180] As part of the effort to deter biological

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175 Personal Interview with Dr. Randall Murch, Virginia Tech, Alexandria, VA, July 18, 2006.

176 Ibid.

177 See FBI Laboratory, Hazardous Materials Response Unit, http://www.fbi.gov/hq/lab/org/hmru.htm. Accessed on March 6, 2007.

178 Personal Interview with Dr. Randall Murch.

179 Ibid.

180 Budowle, "Toward a System of Microbial Forensics: From Sample Collection to Interpretation of Evidence," 2209.

terrorism and strengthen the law enforcement response to such an act, the United States established a microbial forensic laboratory known as the National Bioforensics Analysis Center (NBFAC), which is part of the Department of Homeland Security and operates in partnership with the FBI. The NBFAC now provides a central facility to conduct analysis of evidentiary material. Although the NBFAC's infrastructure and capabilities draw on the best scientific resources available in the United States and on some resources internationally, the practitioners of the nascent field of microbial forensics recognize that there remain significant gaps in both science and operations that must be filled to establish a more readily responsive and effective system.[181]

Despite the creation of NBFAC and other facilities and organizations to assist with microbial forensics in BW investigations, the science remains relatively new.[182] A continued commitment to the development and application of microbial forensics to BW investigations could lead to tremendous advances, and help bring the United States much closer to being better able to quickly identify and attribute a BW attack. As discussed in Chapter II, advances in phylogenetics and epidemiology have greatly advanced the field of microbial forensics, but much more work needs to be done. Scientists have emphasized that the ultimate goal of source attribution is to be able to individualize a sample so that it can be traced to a unique source, but this is unlikely with current capabilities.[183] Forensic specialists used the Amerithrax case as an example of both the successes as well as the limits of microbial forensics.

> Consider the… anthrax letter attack…The data were qualitatively interpreted as the Ames strain and focused the investigation towards laboratory sources. Yet, no further attribution was possible. "Grand leaps" in sequencing technology to increase speed, to reduce cost, and to

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[181] Budowle, "Toward a System of Microbial Forensics: From Sample Collection to Interpretation of Evidence," 2209.

[182] See Mike Nartker, "FBI Science Experiment Could Help Anthrax Investigation," *The Nuclear Threat Initiative, Global Security Newswire*, November 11, 2002. http://www.govexec.com/dailyfed/1102/111102gsn1.htm. Accessed on March 10, 2007.

[183] Budowle, "Toward a System of Microbial Forensics: From Sample Collection to Interpretation of Evidence," 2210.

> maximize efficiency for forensic analysis are needed. Accumulation of the existing genetic information of pathogens and near neighbors into accessible databases is essential.[184]

The continued development and application of forensic microbiology is essential if the United States wants to be able to criminally prosecute or punish someone responsible for a BW attack. Without the ability to collect enough legally sound evidence against a suspect or suspects, any person or group responsible for a BW attack would not be able to be prosecuted in a court of law. Current forensic specialists have emphasized that a strong forensic capability is needed for attribution of animal, plant, and food-borne pathogens and toxins to provide the law enforcement, intelligence, agriculture, public health, and homeland security communities with information to assist in identifying perpetrators of biocrimes and bioterrorism and to serve as a deterrence factor.[185] And although the ultimate prosecution and conviction of someone responsible for BW attack is the common end-goal among all communities, the manner and speed at which the forensics community is able to work is, at times, in contradiction to other organizations' attribution missions.

3. Policy Community: Who Did It?

The policy community's main mission is to protect the American public. When a BW outbreak occurs, the policy community wants to know who is responsible, so that proper political steps can be taken—whether it be stepping up the country's civilian defenses, initiating political negotiations with another country at the peak of an international incident, or implementing military action.

The policy community, however, significantly relies on the intelligence community for information regarding any illegal BW activity, whether it be national or international. High-level policy officials in charge of BW attribution efforts insist that the intelligence community must improve its detection methods so that policy-makers could have evidence that BW activity was actually going on within a state, as well as within our

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[184] Budowle, "Toward a System of Microbial Forensics: From Sample Collection to Interpretation of Evidence," 2211.

[185] Ibid.

own country. This insistence shows that what "attribution" means to a policy official is quite different than what attribution means to a forensic specialists. In fact, one State Department official has insisted that when it came to standards of evidence for BW attribution, the policy community has decided against a "beyond a reasonable doubt" and has instead decided on a "reasonable man standard."[186]

By shifting their standard of evidence to only a "reasonable man standard," the policy community puts themselves in a stronger position to respond to a BW attack, but in a very precarious position when it comes to actually solving and prosecuting the crime, and does little to gain international credibility and support. In addition, the policy community's need to respond quickly to an attack puts their intelligence investigations at odds with the forensic community's need to conduct a thorough and legally sound investigation. This dichotomy has been the source of much contention during the Amerithrax outbreak, as well as other domestic and international investigations.

D. A DOMESTIC CASE STUDY: THE ONGOING AMERITHRAX INVESTIGATION

After 9/11, U.S. defense experts knew that the country needed to remain on high alert, as another attack could be possible. When the anthrax-laced letters began surfacing in the U.S. postal system, as well as at the U.S. Capitol, the country's public health, forensic, and policy community lurched into an even higher state of alertness, and attempted to come together to undertake the largest BW investigation the U.S. has known to date. However, because of the technical and organizational issues between and among the three communities, what became known as the Amerithrax investigation struggled, and eventually revealed the pitfalls of a nation without an established BW attribution infrastructure and policy.

1. Technical Issues

The first reported case in the anthrax outbreak was discovered by an astute physician who noticed his patient's unusual symptoms. Robert Stevens was the first

[186] Assistant Secretary of State Paula DeSutter, Keynote Speech, "Identification, Characterization, and Attribution of Biological Weapons Use Conference," London, UK (July 2006).

fatality in the Amerithrax outbreak, and worked at the tabloid *Sun* in Boca Raton, Florida. After Stevens came down with odd flu-like symptoms, his physician felt something was amiss, but could not concretely identify what was ailing him. The physician ordered some blood tests to be conducted, which were then shipped to a laboratory in Jacksonville, Florida. The lab technician that examined Mr. Stevens' blood samples happened to have just completed his CDC bioterrorism training. As an encouraging testament to the steps in biological defense that the government and the CDC had taken prior to the Amerithrax outbreaks, the technician was able to immediately identify that Stevens had respiratory anthrax, and this information was passed on to the FBI. Due to the preparedness of the lab technician, the public authorities were alerted to the anthrax infection within two days of Stevens' visit with his doctor.[187]

The ability for first responders such as doctors, hospital, emergency personnel, and lab technicians, to be able to identify infections such as anthrax or botulism is the critical first step in being able to determine whether or not an actual outbreak is actually taking place. In fact, Mr. Stevens was not the first anthrax victim to be infected in the Amerithrax outbreak; Joanna Huden of New York City was later confirmed to have cutaneous anthrax, but doctors initially thought she simply had an infected spider bite.[188] After her symptoms began to worsen, Huden went on to see six doctors, and none recognized she had a cutaneous anthrax infection. Only after two weeks had passed and other victims had been diagnosed with anthrax infections did doctors finally suspect that Huden had contracted cutaneous anthrax some time around September 21, 2001.[189]

As detailed in Chapter II, the unique epidemiology of most biological weapons makes it absolutely essential that first responders be trained and up to date on the possible symptoms of a biological weapons-related illness. Without this first line of defense, weeks or months could pass before the public and the government is even aware of the fact that a BW event has taken place. Once the government was aware that anthrax was

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187 Anonymous FBI Interview, June 2006.

188 Thompson, *The Killer Strain*, 100.

189 Thompson, *The Killer Strain*, 99.

being sent through the U.S. postal system in the fall of 2001, it attempted to come together to investigate and attribute the source of the attack. However, this proved significantly easier said than done.

2. Jurisdictional Issues: Organizational Zeitgeist

As detailed above, the three largest communities involved in BW investigations have very different approaches and procedures when attempting to attribute a BW attack. During the Amerithrax outbreak, these differing procedures created numerous challenges, roadblocks, and turf battles that—at times—almost jeopardized the investigation. An FBI official speaking on condition of anonymity told this author that the Amerithrax investigation has been perpetually plagued by something of an organizational zeitgeist, referencing the Hegelian concept of having one's perception of reality being directly influenced by one's limited environment.[190] Due to this organizational zeitgeist and the differing methods and goals of attribution among the public health, forensic, and policy communities, the Amerithrax attacks have highlighted the dangers of not having a cohesive, agreed-upon BW attribution policy, and having a limited perception of reality due to one's own organizational goals can prevent the resolution of one of the largest BW attacks on the United States.

a. The Clash Between the Public Health Community and the Forensic Community

The public health community, led by the CDC, plays a critical role in disease surveillance, and is usually the first line of defense in the event of a BW attack. Due to the unique method of CDC's disease investigations, however, the CDC faced some new challenges during the Amerithrax outbreak, and the zeitgeist—the specific organizational thinking of the public health community's BW investigation techniques—at times came to blows with the forensic community that was also on site during the outbreaks.

190 Anonymous FBI Interview, June 2006.

It was the CDC that was first notified of Mr. Steven's strange symptoms. On October 4, 2001, CDC lab cultures confirmed that Stevens had anthrax.[191] However, even though Stevens had anthrax, the CDC conducted its initial investigation simply as a basic epidemiological investigation, and not as a BW investigation. For, as outlined in Chapter II, anthrax—though rare—is a naturally occurring bacteria and a person can contract an anthrax infection in a natural setting. As such, the CDC began an epidemiological investigation, that, as also previously noted, did not have any homogenous, previously established standard operating procedures.[192]

The CDC sent out investigative teams to scour the locations where Stevens had been before he fell ill, including near his Florida home and work place, and some mountain paths and streams in North Carolina where he had bee hiking with his family.[193] For precautionary purposes, the CDC also contacted the FBI to tell them of Stevens' diagnosis. It was not until the anthrax case was established as criminal in nature that the FBI moved from the secondary to the primary role in the investigation.[194] It was also at this point that the two agencies' organization zeitgeist began to complicate the investigation.

As has been documented, early conflicts between the CDC's epidemiological team and the FBI criminal investigators over evidence collection and witness interviews highlighted the very different cultures of the two organizations.[195] As a testament to the two very different procedures for disease investigation, during the anthrax investigation, the FBI approached each aspect of the case as a crime scene investigation—seeing every item as a piece of possible evidence. Additionally, being knowledgeable of the behaviors and capabilities of weaponized anthrax, the FBI entered each investigation with adequate protection—with masks and gloves, and at times in full

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191 Thompson, *The Killer Strain*, 92.

192 Anonymous FBI Interview, June 2006.

193 Thompson, *The Killer Strain*, 93.

194 Thompson, *The Killer Strain*, 95.

195 Ibid.

HAZMAT suits.[196] To the horror of some of the FBI agents involved, during the earlier parts of the investigation, CDC investigators would show up at an infected location with no masks and no protection, ready to undertake what they felt was going to be a simple epidemiological and environmental sampling.[197] The FBI very quickly informed the CDC of the dangers of weaponized anthrax, and made sure that—despite the CDCs organizational culture—that the publich health investigators working on the Amerithrax case became HAZMAT certified, and made certain that the CDC approach the anthrax investigation as a biological weapons incident, and not a public health outbreak.[198]

An additional incident which highlighted the stark differences in the pubic health community and forensic community's attribution approach, was the incident involving the U.S. Postal Facilities that had sorted and sent the anthrax-letters that began infecting members of the American public. In an effort to calm the American public and attempt to not compound problems by silencing authorities, the White House began allowing CDC doctors to speak directly to the public, and allowed the CDC to be the final say in some instances of what suspected areas were safe and what areas were still possibly contaminated.[199] On October 18, 2001, U.S. Postmaster General John Potter went to the U.S. Postal Service's Brentwood distribution center to try to ease the mounting concerns of the American public and the nation's 800,000 postal workers that the mail, in fact, was safe, despite anthrax being found in letters across the country.[200] As discussed in Chapter II, Potter and his executives had consulted with expert doctors at CDC, as well as the D.C. Department of Public Health. The CDC's top infectious disease specialists had concluded that the facility could not be infected with anthrax, that employees could return to work, and that there was no reason to start the Brentwood employees on preventive antibiotics.[201]

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196 Anonymous FBI Interview, June 2006.

197 Ibid.

198 Anonymous FBI Interview, June 2006

199 Thompson, *The Killer Strain*, 98.

200 Thompson, *The Killer Strain*, 127.

201 Thompson, *The Killer Strain*, 129.

The FBI had no jurisdiction on the decision as to whether or not Potter would be safe going into the Brentwood facility.[202] Knowing the pathogenecity of weaponized anthrax, the FBI tried to warn the CDC of the dangers of allowing anyone into the Brentwood facility, let along the Postmaster General and an entire press conference. The FBI shared its modeling evidence and its information on weaponized anthrax with the CDC specialists, but—possibly due to their limited organizational thinking—they chose to ignore the FBI's advice and evidence, and told Potter and other public officials to feel safe entering the Brentwood facility.[203] The CDC believed there was virtually no risk of any anthrax contamination in the facility, and that without the letter being opened at Brentwood, there was no risk of any anthrax escaping. [204] As was later proven, however, the FBI was correct, and the CDC was wrong in its assumptions. The FBI, however, was not given the authority to make such decisions, and so the investigation and those involved continued to struggle against their own organizational zeitgeist.

During the investigation, both the forensic and public health communities struggled with the lack of a cohesive attribution policy, as well as the lack of an established facility that could assist in examining samples taken from onsite inspections. Once the FBI and the CDC got on the same page as to the standard operating procedures of a criminal disease investigation, both agencies faced a lack of lab support that could test samples that were being collected on site.[205] During one part of the investigation involving the U.S. Capitol mail, the FBI collected over 170 samples in fourteen days that all needed to be tested for the presence of anthrax.[206] The labs that were supporting the investigation, however, could not handle the case load. As a result, the FBI had to

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[202] Anonymous FBI Interview, June 2006.

[203] Ibid. In this author's interview with an anonymous FBI source, the source postulated that the CDC has had less experience and training with weaponized anthrax investigations, versus simply a naturally occurring anthrax outbreak. Because of this—and because of the limits of the scientific information available at the time on aerosolized, weaponized anthrax—some of the CDC investigative team members did not believe the Brentwood facility to be at risk of any further infections.

[204] The Center of Counterproliferation Research, "Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks,"31.

[205] Anonymous FBI Interview, June 2006.

[206] Ibid.

quarantine all remaining U.S. Capitol mail, put it in 635 plastic garbage bags, and then place the garbage bags into 250 sealed drums, so as to prevent hazardous materials from escaping.[207] The FBI did not have enough man power and lab power to test the letters quickly enough, however, and so the members of the FBI investigation team came up with a novel technique to address their limitations. FBI officials trained the onsite HAZMAT workers to take microbiology samples from the sealed U.S. Capitol Mail letters.[208] The FBI forensic specialists trained the HAZMAT workers to collect samples from the letters, swab the sample onto Petri dishes, and then catalogue the Petri dishes.[209] This ingenuity saved a tremendous amount of time, as previously the workers had been simply collecting samples, and then sending the samples to the labs so the lab technicians could transfer the samples to Petri dishes, which the lab technicians would then wait to develop and then analyze. Now, the FBI and the HAZMAT crews were able to send the catalogued samples directly to the lab for a much quicker turn-around. This technique allowed the FBI to cut-off the tremendous backlog in sample analyzation, and in five days accomplished the analysis of a load of samples that was previously taking thirty days to complete.[210] It was this ingenuity that discovered, within those 250 sealed drums, the anthrax-laced letter that has been addressed to Senator Leahy, but fortunately never found its way to Capitol Hill.[211]

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[207] Thompson, *The Killer Strain,* 166.

[208] Anonymous FBI Interview, June 2006.

[209] Anonymous FBI Interview, June 2006

[210] Anonymous FBI Interview, June 2006.

[211] Ibid.

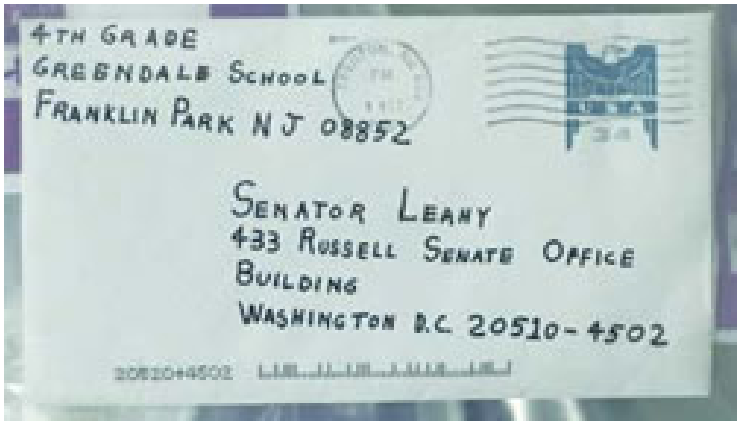

Image 3. The anthrax-laced envelope addressed to Senator Leahy.[212]

The Leahy letter initially registered 20,000 anthrax spores in a quick test.[213] As noted earlier in Chapter II, it takes roughly 2,500 spores to become infected with inhalation anthrax, and a lethal dose of 10,000 spores can be inhaled in one breath. The letter also bore the now infamous childish handwriting and was taped shut, but what appeared to be anthrax was spilling from the envelope when agents were examining it.[214] Due to a misread zip code, this letter's delivery had been stalled, and eventually got quarantined after the discovery of the Daschle letter.[215] Had the Leahy letter been delivered to the Capitol along with the Daschle letter, thousands could have become infected, and many more could have died.

Despite the frustrations and competing organizational cultures between the CDC and the FBI during the Amerithrax investigation, the two agencies were able to coordinate their efforts, as well as create novel techniques to address the short-comings of not having an established BW attribution policy and framework. The lack of such a

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212 From Dave Siff, "One Year Later, Security Tighter; Cities Stretched," CNN, September 12, 2002. http://archives.cnn.com/2002/US/09/06/prepared.cities.overview/index.html. Accessed on March 5, 2007.

213 Thompson, *The Killer Strain*, 166.

214 Thompson, *The Killer Strain*, 167.

215 The letter addressed to Senator Daschle was opened by one of his aids, which forced the government mail service, as well as the U.S. Capitol, to be shut down. More potent than the first anthrax letters, the material in the Senate letters was a highly refined dry powder consisting of approximately one gram of nearly pure spores. Earlier reports described the material in the Senate letters as "weaponized" or "weapons grade" anthrax. However, in September 2006, the *Washington Post* reported that the FBI no longer believes the anthrax was weaponized.

policy, however, certainly caused many problems during the investigation. This not only plagued the FBI and CDC at the outset of the investigation, but five years into the investigation, the differing cultures and attribution aims between the forensic and policy communities continue to plague the Amerirthrax investigation.

b. The Attribution Aims of the Policy Community

The public battle between Congress and the FBI over the speed and direction of the Amerithrax investigation highlights the very different approaches the policy and forensic communities have taken on BW attribution. The policy community wants results, but almost at the expense of a solid investigation. In October of 2006, Congress publicly lambasted the FBI, saying that in five years, "the FBI has little in the way of results to show for its work."[216] The FBI, in turn, told Congress that the Bureau will no longer brief them on the case, since sensitive information about the investigation citing congressional sources was reported in the media.[217] Such leaking of information greatly jeopardizes any legal case the FBI will be able to build against a suspect. However, members of Congress are adamant that they be briefed on the progress and state of the investigation. In December 2006, Senator Charles Grassley insisted that

> In one of the most important terrorism investigations ever undertaken by the FBI, it is unbelievable to me that members of Congress, some who were targets of the anthrax attacks, haven't been briefed for years…As an institution, Congress cannot be cut-off from detailed information about the conduct of one of the largest investigations in FBI history… [Such] information is vital in order to fulfill its Constitutional responsibility to conduct oversight.[218]

Regardless of what the outcome will be in this battle over information sharing, this very public debate highlights the U.S. lack of standard of operating procedures during a biological weapons event and investigation. Who is in charge, who

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216 Jim Popkin, "Congress, FBI Battle Over Anthrax Investigation," *MSNBC*, October 24, 2006. Accessed at http://www.msnbc.msn.com/id/15401908/ on March 6, 2006.

217 Ibid.

218 Joel Seidman and Ken Strickland, "Congress Demands Anthrax Probe Answers," *MSNBC*, December 12, 2006. Accessed at http://www.msnbc.msn.com/id/16173737/ on March 6, 2007.

hears what information, and what the over-all mission is for a BW investigation remains unclear. And in the interim, the policy and forensic communities continue to struggle over the investigation.

Five years after the Amerithrax outbreak, at a recent international conference entitled "Identification, Characterization, and Attribution of Biological Weapons Use," further evidence was uncovered of the disagreement between the policy community and the forensic community over a cohesive national attribution policy. "[219] In July 2006, U.S. Assistant Secretary Paula DeSutter of the U.S. State Department's Bureau of Verification, Compliance, and Implementation gave a keynote speech at an international conference on BW Attribution. DeSutter spoke on the record of the main policy challenges that BW attribution placed on the current U.S. government. The Secretary told the group that her Bureau's main responsibility was—in the event of a state or non-state actor actually using biological weapons either at home or abroad—to be able to go to the President and say, "Mr. President, here is who did it, and here is who we stop from doing it again."[220]

From her remarks, it was clear that the Secretary's main tool for investigating and attributing international BW outbreaks was intelligence. Although intelligence is a necessary element of BW attribution, the fact that the policy community so heavily focuses on intelligence and inter-agency information sharing puts their policy at direct odds with the forensic communities need to conduct a closed investigation for the purposes of securing evidence for an eventual criminal prosecution.

In fact, at one point during the conference, an American participant with extensive experience in microbial forensics with the FBI asked the Secretary what the

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219 All of the information on AS DeSutter's speech was witnessed and taken down by this author at an unclassified international conference organized by the Center for Contemporary Conflict, U.S. Naval Postgraduate School, in collaboration with King's College London Centre for Science and Security Studies and the Economic and Social Research Council (UK), and with support from the Advanced Systems and Concepts Office, U.S. Defense Threat Reduction Agency. The conference took place in London, UK, in July 2006. See: http://www.ccc.nps.navy.mil/events/recent/bwconferenceDec06_rpt.asp.

220 "Identification, Characterization, and Attribution of Biological Weapons Use," Conference Proceedings, July 2006. See Dr. Anne Clunan, Dr. Peter Lavoy, and Elizabeth Stone, "Identification, Characterization, and Attribution of Biological Weapons Use," London, UK, July 12-13, 2006. Accessed at: http://www.ccc.nps.navy.mil/events/recent/bwconferenceDec06_rpt.asp, on March 6, 2007.

U.S. government's definition of attribution was. DeSutter said that policymakers do not think of BW attribution in the same terms as forensic specialists. She said the policy community's focus is not on long term deterrence and future prosecution of a crime; rather, their priority is simply collecting enough intelligence to be able to make an educated enough guess as to who the perpetrator is because "both leadership and the public is going to want something about [the BW outbreak] right away."[221] She insisted this was why her standard of evidence for BW attribution was not "beyond a reasonable doubt," and was instead a "reasonable man standard."

At another point in the conference, a British participant with prior experience in BW investigations emphasized to DeSutter that with BW attribution being a transnational problem in a complex international environment, U.S. policymakers should realize that investigation mechanisms are most supported by the international community when they can gain credibility before they are needed to be used. The Secretary responded by noting that the standards of evidence of what is sufficient to initiate a BW investigation are still unclear in the international community, and need to be made as low as possible.[222] She insisted that governments should not have to have actual proof of BW use before they are able to collect intelligence and investigate any suspicious outbreak or activity. AS DeSutter insisted that governments "need to act when there's smoke, because once there is a fire, people will die."[223]

DeSutter's comments reflect the opinion of the current administration's view of the standard of proof needed for attribution, and also highlight the conflict between the domestic policy community and the legal/forensic community's definitions and goals of BW attribution. Other members of the conference—international participants representing other state governments, as well as other American participants

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221 "Identification, Characterization, and Attribution of Biological Weapons Use," Conference Proceedings, July 2006. See Dr. Anne Clunan, Dr. Peter Lavoy, and Elizabeth Stone, "Identification, Characterization, and Attribution of Biological Weapons Use," London, UK, July 12-13, 2006. Accessed at: http://www.ccc.nps.navy.mil/events/recent/bwconferenceDec06_rpt.asp, on March 6, 2007.

222 "Identification, Characterization, and Attribution of Biological Weapons Use," Conference Proceedings, July 2006. See Dr. Anne Clunan, Dr. Peter Lavoy, and Elizabeth Stone, "Identification, Characterization, and Attribution of Biological Weapons Use," London, UK, July 12-13, 2006. Accessed at: http://www.ccc.nps.navy.mil/events/recent/bwconferenceDec06_rpt.asp, on March 6, 2007.

223 Ibid.

who had worked on BW issues in previous administrations—disagreed with DeSutter and insisted that a more thorough standard of proof should be required for BW investigation and attribution, both domestically and internationally. A BW investigation requires an established standard of proof since it is a criminal investigation. In the American legal community, a probable cause standard—which is more stringent than a reasonable man standard—is most often needed before a magistrate will approve a search warrant for an investigation into any suspected illegal activity. Unless investigators can meet the probable cause standard of proof, a search warrant will not be issued, and any evidence obtained in absence of a valid search warrant cannot be used at trial.

DeSutter's comments suggest that the policy community needs immediate and only reasonably credible information on BW use, so that proper defensive and political steps can be taken to protect the American public in the event of a biological weapons attack. Requiring a lower standard of proof can be detrimental, however, as this means much less intelligence and "proof" is needed for the government to initiate a domestic or international BW investigation into a company, state, or an individual's activities. Additionally, a lower standard of proof, especially in a domestic U.S. investigation, could ultimately jeopardize any evidence that is collected, and may ultimately undermine the investigation. Investigators may be able to identify and attribute the source of an attack, but because they did not abide by Constitutionally mandated standards of evidence collection for a federal criminal trial, the perpetrator could be

acquitted.[224] Additionally, on an international level, if any sort of retaliation from a suspected BW attack remains on the table—especially a nuclear retaliation, as the United States has reserved as an option—then a higher standard of proof will almost definitely be demanded and required.

DeSutter's comments highlight the difficulty of establishing the requisite standard of proof for BW investigations. Should the policy community have a lower standard of proof requirement in order to act when there is smoke, rather than fire? DeSutter's comments make it apparent that the current U.S. policy community's lexicon of attribution is quite different than the U.S. forensic and legal community, as well as other international governments, and it seems that "proof" to a U.S. policy maker is not the same type of "proof" one can present in an American criminal trial.[225] However, this issue will have to be resolved if and when the source of a BW attack is identified, attributed, and brought to trial.

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[224] The Constitutionally mandated standard of proof for the *conviction* of all criminal charges, at both the State and Federal level, is proof beyond a reasonable doubt. The requisite standard of proof to initiate a search warrant for federal criminal charges, under the Fourth Amendment, is the probable cause standard. Probable cause sufficient to justify a search/ investigation usually amounts to "the quantity of facts and circumstances within a law official's knowledge that specific items related to criminal activity will be found at particular place." See Robert Bloom, *Criminal Procedure: Examples and Explanations, 4th Edition* (New York: Aspen Publishers, 2004), 125. Since any domestic trial resulting from a BW investigation would most likely take place in a federal court (due to federal investigation and most likely inter-state crime scenes and victims) it is possible that Congress could statutorily amend the standard of proof requirement specifically for federal BW investigations. If Congress felt a lower standard of proof—like DeSutter's suggested reasonable man standard—is a better standard for BW investigation warrants, than Congress could pass such a statute, and any evidence collected under a reasonable man standard during a BW investigation would then be allowed in a federal trial. A reasonable man standard, or sometimes called a "reasonable suspicion" standard, usually only requires a reasonable suspicion of criminal activity to a degree that can be reasonably articulated—a much lower standard that requires must less proof and specifics than a probable cause standard. At present, the standard of proof required to initiate an investigation for most federal criminal trials remains a probable cause standard.

[225] A reasonable man standard is also problematic if the U.S. government wants to initiate an international BW investigation. Under Article VI of the BTWC, any state party that suspects another state party of violating the Convention can report the matter to the UN Secretary Council, which, in turns, evaluates the evidence to see if the suspicions are credible and an investigation is warranted. Although the BTWC does not specify what standard of proof is required before a state can report another state to the UN Security Council, almost definitely a higher, probable cause standard of proof will be required before the UNSC launches an international investigation into another state's territory. As a party to the BTWC, the United States would almost certainly require more than a preponderance of the evidence standard before it allows an investigation into its territory. Otherwise, state parties could merely use a low preponderance of the evidence standard to initiate propaganda-driven investigation requests.

E. CONCLUSION

Article Four of the BTWC insists that each nation must police its own country to ensure treaty compliance.[226] When the United States ratified the BTWC in 1975, it was required by Article Four to adopt any national measures necessary, in accordance with the American constitutional processes, to prohibit and prevent the banned activities detailed in Article One of the treaty. It seems, however, that because the treaty does not prescribe the type of measures that should be adopted, the United States did not feel rushed to develop its own BW investigative and attribution capabilities. Twenty-six years later, the lack of such a policy establishing a BW attribution capability proved almost crippling to the Amerithrax investigation.

As has been noted, the investigation remains open and unsolved. This sobering reality cannot be pinpointed on any one agency. Until the major players involved in BW surveillance, investigation, and response can develop and agree upon a common definition of BW attribution, and also agree upon a common end-goal of a BW investigation, a national attribution capability will remain undeveloped. The public health and forensic communities have made great strides in streamlining and coordinating their efforts in a BW investigation. The ongoing battle between the policy community and the forensic community over the status of the investigation, however, shows that their starkly contrasting organizational zeitgeists continue to prevent them from seeing eye to eye.

A successful domestic BW attribution capability is contingent upon a single, cohesive attribution zeitgeist among all the communities involved in BW investigations. The Amerithrax event and its ongoing and daunting investigation should serve as a wake-up call to the policy community that, despite their own objectives, the nation needs a cohesive attribution policy if we are ever to truly answer the question: who did it?

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226 Mangold, *Plague Wars*, 59.

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VI. CONCLUSION

A. RE-EXAMINING THE DETERRENCE CONUNDRUM

The possibility of an enemy attack using BW on U.S. soil or U.S. allies or troops abroad remains one of the biggest threats to U.S. and global security. If "deterrence is the historical cornerstone of U.S. defense,"[227] the current policies of U.S. biodefense measures must credibly convince potential criminals to not engage in criminal and deviant activities for fear that they will be apprehended and punished. In order for a BW user to fear punishment, norms, laws, and enforcement must be designed and implemented to enable governments to attribute attacks to perpetrators and to communicate that capacity to would-be attackers.

The current norms, laws, and BW enforcement policies are significantly lacking in their abilities to identify and attribute BW outbreaks and to date have failed to apprehend and punish BW violators. Thus, BW deterrence is falling short of its policy objectives. Despite the advances the U.S. government has made in the wake of the 2001 Amerithrax attacks, this thesis has shown there is still significant room for further advances. As Dr. Randall Murch of Virginia Tech told this author, "The United States still lacks a comprehensive biological weapons attribution strategy. The current "Biodefense for the 21st Century" policy is not a strategy—it's a vision of what a biodefense strategy should be."[228]

This thesis has presented three major challenges to the successful attribution of a biological weapons attack: the nature of the weapons themselves, and the constraints created by international laws and domestic politics. It is only by understanding the complex nature of each of these elements, as well as the intricate manner in which these three elements are interrelated, that a successful BW attribution policy can be created and implemented. Each of these independent elements is a critical component of deterring and eventually attributing the source of a future, or current, biological weapons threat.

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227 "Biodefense for the 21st Century," The White House, April 28, 2004.

228 Interview with Dr. Randall Murch, July 18, 2006.

B. THE BW ATTRIBUTION TYPOLOGY: IDENTIFY, CHARACTERIZE, AND ATTRIBUTE

The unique nature of biological weapons creates a three-pronged typology during an investigation of suspected BW use. First, a biological weapons incident must first be identified. Often times, disease epidemics can go unnoticed for quite some time before public health communities even recognize that a genuine outbreak has, in fact, occurred. Second, a disease outbreak must be characterized as a deliberate release of a biological weapon, and not simply a natural disease outbreak. And last, once a disease outbreak has been ruled as a deliberate criminal incident, the attack must be attributed to the perpetrator.

The success of this typology greatly depends on the epidemiological understanding of the disease agent involved in the outbreak, the cooperation of the international community and the effectiveness of international laws governing BW use, as well as the domestic BW attribution policies and procedures (whether domestic U.S. policies of the domestic policies or the state in which the BW attack has occurred) that should assist in the investigation of the attack. Therefore, the attribution of the BW attack, as well as the deterrence of any future BW attack, directly relies on the successful implementation of a BW attribution policy that considers and incorporates all three of these elements.

1. Deterrence from an Epidemiological Perspective

Because infectious diseases can be classified according to their epidemiologic, clinical, and/or microbiologic features, detailed knowledge of these characteristics is a critical component for the expeditious identification, investigation, and attribution of a BW agent. Additionally, because biological weapons lack a tell-tale signature—unlike nuclear or chemical weapons—the understanding and knowledge of the epidemiological characteristics of suspected BW agents is essential if a disease outbreak is ever to be suspected as a deliberate BW attack.

Chapter II of this thesis detailed the importance of understanding agent epidemiology. Because agents used for BW agents are live, naturally occurring organisms, understanding an agent's pathogenicity, infectivity, incubation period, and

virulence in a natural environment is essential to understanding how that same agent would act if it were to be weaponized. As has been repeatedly emphasized, the public health community as well as the disease surveillance community is the first line of defense in a BW attack, as they must be the first to recognize and identify that a biological weapons event has, in fact, occurred.

Additionally, as has been shown throughout this thesis, disease epidemiology is a critical component to microbial forensics. Without a thorough understanding of an agent, as well as the ability to collect sound microbial evidence from the "scene" of a BW event, the law enforcement community will not have strong enough evidence to prosecute those responsible for the event once the attack has been attributed.

Therefore, epidemiology is a critical component of all three prongs of the attribution typology. Without, the identification, characterization, and attribution of a biological weapons event would be impossible.

2. Deterrence from an International Perspective

Equally as critical to an attribution typology is a thorough understanding of the international laws and the history surrounding current international treaties governing biological weapons events. As was noted above, BW attribution is a complex and transnational problem. Diseases, whether natural or unnatural, know no boundaries. The Sverdlovsk case study within this thesis depicted the challenges and complexity of an international BW incident. The lessons-learned of this event have been studied and published numerous times. Nearly twenty years passed between the release of anthrax in Sverdlovsk, and the attribution of the event. And, despite the scientific evidence that Western scientists possessed, the reason the Sverdlovsk event was finally officially attributed was simply because then President Yeltsin of Russia publicly admitted to the accidental release of anthrax from an old USSR military installation.

The challenges of the attribution typology—identifying, characterizing, and attributing a disease outbreak—remain just as complex in the contemporary international environment as was true during in 1979 during the Sverdlovsk incident. U.S. policymakers must realize that BW investigation mechanisms are most supported by the international community when they can gain credibility before they are needed to be

used. The United States was unable to officially investigate the Sverdlovsk incident in 1979, due to a lack of an agreed upon international BW investigative mechanism; and sadly, there remains no international BW investigative mechanism. As such, the weaknesses of the current Biological and Toxins Weapons Convention (BTWC) must continue to be strengthened—both at the international level, as well as at the domestic level where the mandates of the treating need to be implemented into national legislation.

If U.S. troops or allies abroad were to be attacked with biological weapons, it is very possible that the attribution of the event would be impossible. Without internationally agreed upon laws that allow BW investigation teams to quickly enter into a state's sovereign territory, critical evidence of the attack will be lost, and so will the chances of attribution.

As with most areas of international law, the precise manner in which such a policy should be implemented is and has been hotly debated, both at home and abroad. Despite differing perceptions of what type of policy would be best, the United States and all other members of the BTWC must make this issue a top priority. Without an agreed upon international framework for intra-state BW investigation, the identification and characterization of a BW event may be possible, but the attribution of the event will be unlikely.

3. Deterrence from a Domestic U.S. Perspective

Since the United States implemented the BTWC, fives presidents and nine administrations have sat in the White House. Undoubtedly, biological weapons proliferation and use has been a concern of each of these administrations. Despite these concerns, however, none of the administrations to date has successfully addressed or implemented an effective national biological weapons attribution policy.

Two of the biggest impediments to a successful domestic BW attribution capability is simply lexicon and organizational zeitgeist. The domestic agencies involved in BW investigations—the public health and disease surveillance community, the forensics and law enforcement community, and the policy community—must synchronize to cohesively create not only an effective attribution policy, but also shared and agreed upon standard operating procedures for BW investigations. This capability

has been slowly evolving since 1996, but it must continue to evolve and advance. As the Amerithrax case study has shown, there remain significant hurdles and problems in national BW investigations. The lessons learned from the Amerithrax investigation, as well as older investigations like the Sverdlovsk incident, must be taken into consideration and corrected.

C. POLICY RECOMMENDATIONS

Without an effective BW attribution policy, the United States remains extremely vulnerable to future BW attacks. It has been over five years since the Amerithrax attacks, and the perpetrator(s) of the attacks remain(s) unknown. This sobering fact not only makes Americans less safe, but it also sends a strong and negative message to any would-be BW attackers. Future BW criminals see that, even in one of the strongest countries in the world, biological weapons remain the poor-man's nuclear weapon. Just a small amount of expertise and capital is needed to induce wide-spread destruction—both in terms of potential lives lost, as well as economically. One FBI documents estimates that the ongoing Amerithrax investigation has already cost the U.S. government over $1 billion in investigation and decontamination costs.[229] The psychological impact on ordinary citizens of this reality is, of course, immeasurable.

However, in addition to impeding any future BW investigation, the lack of a sound national and/or international BW attribution policy puts something even larger at stake: deterrence. Current and traditional approaches to U.S. defense and deterrence policies are based on the assumption that the perpetrator can be easily and reliably identified, and those planning or responsible for attacks will be punished. If perpetrators can conduct attacks without the fear or possibility of punishment, they can act with impunity. The ability to punish, therefore, rests on the ability to identify the perpetrator. Thus, attribution is at the root of all national security strategies of deterrence by punishment.

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[229] Allen Lengel, "Little Progress In FBI Probe of Anthrax Attacks," *Washington Post* (September 21, 2005). Accessed at: http://www.washingtonpost.com/wp-dyn/content/article/2005/09/15/AR2005091502456_pf.html, on 11 March 2007.

The notion that members of the current administration, as well as past administrations, view BW attribution as an intelligence issue whose goal is to collect enough intelligence to make an educated guess, using the reasonable man standard—rather than a beyond a reasonable doubt standard or a probable cause standard—is a frightening thought. Although such a policy could be quite effective in the short-term, allowing policy makers to quickly respond to a domestic or international BW incident, it almost entirely defeats any long term deterrence goals.[230]

The United States has reserved the option of using nuclear weapons in response to a biological or chemical weapons attack. [231] This fact and this fact alone should be enough to convince policy makers that BW attribution cannot be thought of as simply an intelligence issue that requires the low threshold of a reasonable man standard; for as the United States has learned, intelligence is not a fail proof deterrence tool—and the international and domestic repercussions of such failure are tremendous. If the possibility of nuclear retaliation is to remain a viable deterrent option to BW use, the quick, efficient, and reliable attribution of BW use is an absolutely critical component to such a deterrence policy.

Therefore, in order for the threat of BW use to be quelled and/or eventually defeated, the attribution problem is critical. Three main policy recommendations on biological weapons attribution can be taken away from this thesis:

- (1) BW attribution is not just a technical problem. Policy-makers must work with scientists to improve the capabilities and understanding of forensic microbiology and epidemiology so investigations can more easily identify the capabilities of a given organism in the event of a BW attack. Additionally, a standing team of neutral, internationally chosen and agreed upon BW investigators must remain trained, equipped, and deployable. This team should have the capabilities to be

[230] See footnotes 224 and 225 for further discussion.

[231] See Victor A. Utgoff, "Nuclear Weapons and the Deterrence of Biological and Chemical Weapons," *Henry L. Stimson Center Occasional Paper* no. 36 (October 1997). Accessed at: http://www.stimson.org/wmd/pdf/utgoff.pdf on 11 March 2007.

deployed any where in the world in the event of a BW attack to collect the necessary epidemiological and forensic evidence needed to attribute a BW outbreak.

- (2) The United States cannot solve the BW attribution problem if it acts in isolation. Disease—naturally occurring or deliberately released—knows no boundaries; the attribution of a biological weapons, therefore, is truly a transnational issue. The United States must comply with established international treaties and agreements in order to gain the credibility and trust necessary for coordinating international BW investigations.
- (3) Domestically, U.S. policy makers must push for new laws and standard operating procedures in the event of a domestic BW attack. Many advancements have been made in the wake of the hard lessons learned during the Amerithrax outbreak, but a clear and coherent plan of action must be solidified into law, determining not only the hierarchy of which government agencies will be in charge of all the aspects of a BW investigation (investigation in general, evidence collection, sample testing, etc.), but there remains a need for inter-agency SOPs of evidence collection and testing. Any samples or evidence collected for a BW investigation must be of a high enough caliber that the evidence could withstand the scrutiny of the legal community's standard of evidence. An ubiquitous and Congressionally-approved standard of proof must be established for BW investigations and be adhered to by the policy, legal, and forensic communities to ensure not only the attribution of a BW attack, but also the ultimate prosecution of those responsible for the attack, and the deterrence of any future attacks.

Without the fear of punishment and/or robust consequences, future BW users will remain undeterred. Though the unique characteristics of biological weapons make attributing who used or released them extremely difficult to determine at times, attribution is possible. With a firm understanding of the challenges of BW attribution, the

United States will be in better position to reliably attribute the source of a BW attack, and respond as specified in its national security and defense strategies.

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